ELEMENTARY CRAFTWORK IN METAL

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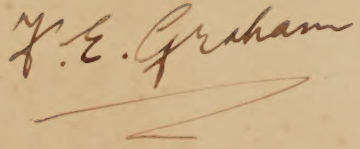

ELEMENTARY CRAFTWORK IN METAL

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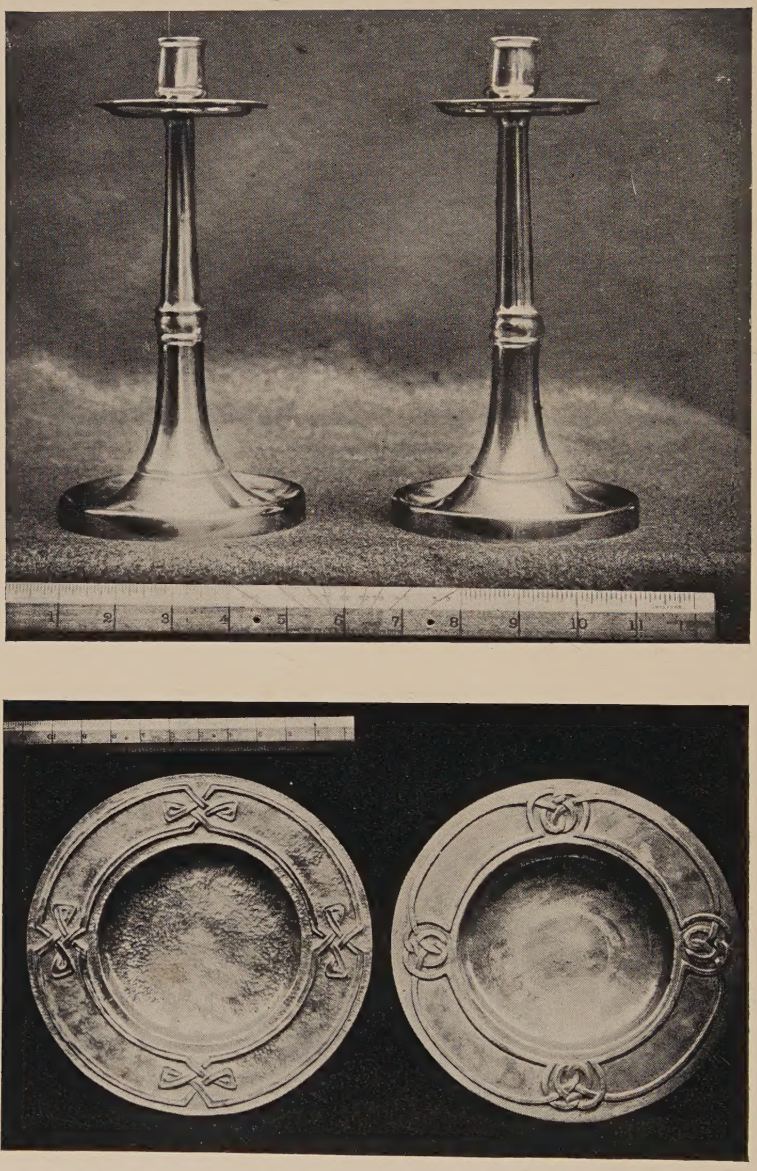

EXAMPLES OF HAND-TURNED CANDLESTICKS
AND HAMMERED PLATES

ELEMENTARY CRAFTWORK IN METAL

AN INTRODUCTION FOR THE USE OF TEACHERS STUDENTS AND WORKERS

BY

ALFRED J. SHIRLEY

JOINT AUTHOR OF "HANDICRAFT IN WOOD AND METAL"
LECTURER AND EXAMINER IN METALWORK

LONDON
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First published 1928

The book deals with and illustrates descriptive working drawings and tools, and presents a progressive series of models which usually have decorative character and show the application of design to handwork

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PREFACE

In preparing this book the Author has endeavoured to show some of the possibilities and limitations of metalwork, and to give teachers and students some knowledge of the scope of the subject in a school.

He realises that a metalwork teacher has to teach his subject and at the same time to produce various objects, and bearing this in mind, has arranged his book in four sections.

The first section covers what he has to say on Design, and is to be regarded as fundamental. The second section gives a brief résumé of the chief materials and processes. The third and more detailed section elaborates in a graded series of models his practical suggestions, while the last short section gives some important tables, a glossary, and other miscellaneous information.

He has purposely omitted much valuable information which should be part of the equipment of a metalwork teacher, owing to the fact that the time that it is possible to devote to metalwork in schools is strictly limited. The method adopted in teaching this subject has been to give a short lesson on theory, to follow this with the preparation and discussion of a working drawing which the students and teacher make in collaboration, to build up a statement of the procedure to be followed, and finally to make the model. A student who has worked through this course will have gained a fair knowledge of drawing, materials, tools and practical processes in various metals.

In the early stages of the work accuracy, while being encouraged, should not be too strictly demanded. Insistence on accuracy should increase with the skill of the student. Simplicity and good proportion and the correct use of material should be insisted on throughout, and so, many of the models show variations in treatment and design.

Many of the models illustrated have been designed and prepared in connection with the author's duties at the L.C.C.

Shoreditch Technical Institute Training College for Teachers and Day Technical School. For permission to reproduce these the author desires to thank the Principal, Shadrach Hicks, Esq. The author gratefully acknowledges his indebtedness to Mr. A. G. Scrivens, B.A., B.Sc., for his valuable assistance and kindness in reading the proofs.

Under Standing Order No. 342 of the London County Council, it must be stated that the L.C.C. accepts no responsibility for any opinions or conclusions appearing in this book.

ALFRED J. SHIRLEY.

LONDON, 1927.

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I

DESIGN AND ITS APPLICATIONS

SINCE mid-Victorian days, and due largely to the publicity given to Ruskin's writings, craftsmen have been busy discussing the fundamentals of design. They have in all ages practised designing, but the abstract discussion and analysis of these problems is a comparatively recent development.

In one of his lectures, when the audience was eagerly waiting to hear Ruskin's definition of design, he refused to give recipes and merely ventured the great principle that ' truth, tenderness and inventive application or disposition are the roots of ornament.' A man designs, then, when he selects some things, refuses others and arranges them into a complete whole. This can only be done by one who possesses a knowledge of many forms and of the possibilities and limitations of the material he wishes to use.

True design is not merely a matter of decoration. Ornament may add to the beauty of a well-planned and well-made article provided that its usefulness is not thereby impaired, but ornament alone can never make a bad thing good. Design is the devising of the form, construction and treatment of an object to fit it perfectly for its use. This faculty of design, which must be exercised whether the object is to be made by machinery or by hand, depends on one's sense and judgment and the ability to select the most suitable shape or form for the job so that it just suits its purpose. Form and construction are so interdependent that quite often they are one and the same thing.

Given a good design, ornament may then be added. This should neither interfere with the usefulness of the object nor seek to imitate other processes or materials. The keynote of all the best Greek Art is simplicity, and this simplicity is the last term in a long series of experiments in pruning away all irrelevancies and distractions.

A proper knowledge of the right use of material and ornament is best acquired by the study of acknowledged good examples, either at the museums or from photographic reproductions. Even at a museum a student must discriminate between the

work done by a genius who allows his technical skill to outrun his artistic judgment and the masterpieces which subordinate the technical skill to a proper balance between good taste or form and necessary ornament.

In designing for metalwork in schools the designer is governed by certain factors :

A. Equipment.
B. Available material.
C. Capacity of student craftsman.
D. The designer's knowledge of possibilities and limitations of the materials.
E. A style of drawing that can be understood by the young student and skilled craftsman alike.

When a model has been decided upon—such as a bowl or a candlestick—a large number of similar objects should have been examined, and the various sizes, shapes and forms of decoration studied. Any individual parts that can be made under the existing conditions of equipment, material, tools and skill of the students are duly noted. The original idea modified with hints from the above information is now drawn out on paper to the proper size. Working drawings are made from this, and the work executed in the appropriate material.

We have now something tangible which can be examined and criticised in detail, and it is now possible to decide upon necessary and suitable modifications. It is, in the author's view, absolutely essential that the teacher should make each job before expecting a class of students to carry out the work. This will not only avoid many harassing moments and show the teacher the impossibilities, difficulties and dangers to be avoided, but has the merit of following out the very process by means of which good metalwork has always been achieved.

II

BRIEF NOTES ON MATERIALS AND PROCESSES

SUGGESTED TOPICS FOR LESSONS

These are Suggestions for Class Lessons to be given in Conjunction with the Practical Work Developed in Section III of the Book.

Materials.

Metals.
Alloys and their composition.
Carbon steel and special steels.
Methods of distinguishing between various kinds of iron and steel.
Characteristics of metals and alloys.
Production of metals from their ores.
,, ,, tinned plate.
Commercial sizes of materials.
Nomenclature used in the metalworking trades.

Tools.

Hammers.
Files.
Smiths' tools.
Tinmans' tools.
Coppersmiths' tools.
Pliers.
Spanners and wrenches.
Taps, dies, and screwing tools.
Cutting tools, hand and machine.
Measuring tools and gauges.
Vices.

Processes.

Annealing, hardening and tempering.
Forging.
Drilling.
Punching and raising.
Turning (machine and hand).
,, tools and lubricants.
Soft soldering.
Hard soldering and brazing.

Welding : (*a*) Smiths' fire.
(*b*) Autogenous.
(*c*) By means of gases.
(*e*) Electric.
Rivets and riveting.
Cleaning metals.
Dipping, bronzing and colouring.
Polishing and plating.
Tinning and galvanising.
Screws and screwing, hand and machine.
Drawing and extruding metals.
Casting in iron.
,, brass, copper and gunmetal.
Moulding and coremaking.
Cire perdue casting.
Die casting.
Preserving metallic surfaces.

NOTES ON MATERIALS

METALS

The broad definition of a ' Metal ' is that it is :

A solid opaque body possessing a peculiar lustre, fusibility, and conductivity.

Those metals which are most frequently employed in commerce and the arts are as follows :

Metal.	Symbol.	Colour.
Aluminium	Al	Tin white.
Antimony	Sb	Silver white.
Bismuth	Bi	White.
Cadmium	Cd	White, blue tinge.
Chromium	Cr	Greyish white.
Cobalt	Co	Steel grey.
Copper	Cu	Reddish yellow.
Gold	Au	Yellow.
Iridium	Ir	Grey.
Iron	Fe	Greyish white.
Lead	Pb	Blue grey.
Magnesium	Mg	Silver white.
Manganese	Mn	White grey.
Mercury	Hg	White.
Molybdenum	Mo	Dull Silver.
Nickel	Ni	White.
Osmium	Os	Blue white.
Platinum	Pt	White.
Silver	Ag	White.
Tantalum	Ta	White
Tin	Sn	Silver white.
Tungsten	W	Steel grey.
Vanadium	V	Light grey.
Zinc	Zn	Bluish white.

In the workshop the name ' metal ' is applied to both the pure metals and the alloys, and it is so used in these pages.

ALLOYS

When two or more metals are caused permanently to unite the resulting mixture is called an *Alloy*. The term is also used for similar mixtures of metals and non-metals, such as iron and carbon = steel. The melting point of an alloy is usually below that of the most easily fusible constituent.

Amalgam. When mercury is one of the metals the mixture is generally known as an amalgam.

It is not necessary in this work to give the names of all the known alloys, as many of them are made for a special purpose or industry, and as these purposes are as varied as the number of alloys it is possible to make, and new combinations of metals are continually being invented, only the more common ones will be dealt with.

Alloys can be divided into two large classes :

Ferrous alloys, that is, alloys containing iron.

Non-ferrous alloys, that is, alloys containing no iron.

[The following table gives the more common alloys and their composition.]

Alloys: their Names and Composition.	Copper.	Antimony.	Aluminium.	Tin.	Zinc.	Lead.	Silver.	Manganese.	Nickel.	Phosphorus.	Iron.	Gold.	Carbon.	Tungsten.	Magnesium.	Chromium.
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Aluminium bronze	95	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—
Brass	65	—	—	—	35	—	—	—	—	—	—	—	—	—	—	—
Britannia metal	2	8	—	90	—	—	—	—	—	—	—	—	—	—	—	—
Bronze	90	—	—	10	—	—	—	—	—	—	—	—	—	—	—	—
Delta metal	56	—	—	—	41·61	·72	·81	—	—	·013	·87	—	—	—	—	—
Dutch metal	80	—	—	—	20	—	—	—	—	—	—	—	—	—	—	—
Duralumin	3½ to 5	—	95	—	—	—	½ to 8 or ¼	—	—	—	—	—	—	—	½	—
German silver	46	—	—	—	20	—	—	—	34	—	—	—	—	—	—	—
Gilding metal	83	—	—	—	17	—	—	—	—	—	—	—	—	—	—	—
Gold (standard)	8·34	—	—	—	—	—	—	—	—	—	—	91·66	—	—	—	—
,, solder (best)	63	—	—	—	7	—	30	—	—	—	—	12½	—	—	—	—
Gunmetal	90	—	—	10	—	—	—	—	—	—	—	—	—	—	—	—
Manganese bronze	56	—	0·25	0·9	40·6	—	—	2	—	—	0·25	—	—	—	—	—
,, steel	—	—	—	—	—	—	—	14	—	—	86	—	—	—	—	—
Muntz metal	62	—	—	—	38	—	—	—	—	—	—	—	—	—	—	—
Nickel steel	—	—	—	—	—	—	—	·8	25	—	74	—	—	·2	—	—
Ormolu	58	—	—	17	25	—	—	—	—	—	—	—	—	—	—	—
Pewter	—	—	—	82	—	18	—	—	—	—	—	—	—	—	—	—
Phosphor bronze	90	—	—	9¼	—	—	—	—	—	¾	—	—	—	—	—	—
Silver (standard)	7·5	—	—	—	—	—	92·5	—	—	—	—	—	—	—	—	—
,, solder (best)	22	—	—	14	—	—	64	—	—	—	—	—	—	—	—	—
Spelter (for brazing)	50	—	—	50	—	—	—	—	—	—	—	—	—	—	—	—
Steel (for tools)	—	—	—	—	—	—	—	—	—	—	98¾	—	1¼	—	—	—
,, (mild for forging)	—	—	—	—	—	—	—	—	—	—	99·85	—	·15	—	—	—
Stainless steel	—	—	—	—	—	—	—	—	—	—	88	—	·1 to ·40	—	—	12·14
Tinman's solder	—	—	—	66·6	—	33	—	—	—	—	—	—	—	—	—	—
Tungsten steel	—	—	—	—	—	—	—	2½	—	—	91½	—	1½	4½	—	—
Type metal	—	15	—	2	—	83	—	—	—	—	—	—	—	—	—	—
White metal	8	8	—	84	—	—	—	—	—	—	—	—	—	—	—	—

THE CHARACTERISTICS OF METALS AND ALLOYS

All metals have their own particular characteristics, and it is this knowledge that enables a craftsman to design and make a varied assortment of tools and models. It is sometimes important to know for some specific metal what are its peculiar characteristics, such as :

Density or specific gravity.
Lustre or sheen—reflection of light.
Conductivity of heat.
Conductivity of Electricity.
Fusibility.
Expansion by heat.
Solidification after fusion.
Contraction.
Hardness and softness.
Malleability.
Ductility.
Tenacity.

METHODS OF DISTINGUISHING SOME VARIETIES OF IRON AND STEEL.

Test.	Cast-iron.	Wrought-iron.	Mild Steel.	Carbon Tool Steel or Cast Steel.
Appearance.	Grey, sandy, always shows mark of runner and line of casting.	Red, scaly, shows signs of rolling.	Fine, smooth, with blue sheen.	Very smooth, fine glittering black sheen.
Sound.	Very dull note.	Dull, but higher than cast-iron.	Medium note.	Fine ringing high note.
Strength.	Very weak in tension or torsion, but strong in compression; not safe when subject to compact or suddenly applied loads.	Fairly strong in tension or torsion, but whips in compression, where it is not so strong as cast-iron.	Strong in compression, tension and torsion.	Very strong in tension, compression, and torsion.
Cut halfway through bar and bend.	Very brittle; snaps easily.	Bends well before breaking.	Bends a little, then snaps.	Difficult to bend; when started bends very little, then snaps with a sharp report.
Fracture.	Large crystals with specks of free carbon.	Fine fibrous structure.	Medium crystalline structure.	Very fine crystalline structure, closely-packed crystals.
Heat to redness, and hammer.	Crumbles under the hammer, and large pieces drop off the bar.	Works easily; can be drawn out and welded.	Works well, not so easy as wrought-iron; can be welded with care.	Works well, but very hard. Can be welded with care if less than 1 per cent. carbon.
Heat to redness, and cool by immersion in water.	No change, or cracks by uneven contraction; some irons harden, but only on the outside skin.	No change, or, if chemically pure, softens slightly.	No change, or hardens slightly (steel made by Bessemer process hardens most).	Becomes intensely hard and brittle.
Brighten, then spot with nitric acid.	Black stain.	Green stain.	Brown stain.	Brown to black stain, varying with percentage of carbon.
Composition.	Up to 5 per cent. carbon, with varying small quantities of sulphur, phosphorus, silica, and manganese.	Chemically pure iron, but usually contains small percentage of sulphur and phosphorus.	Up to 0·5 per cent. of carbon; with small amount of sulphur, phosphorus, and manganese.	0·5 to 1·5 per cent. carbon, usually pure, but may contain traces of sulphur and phosphorus.

CARBON TOOL STEEL

An alloy of iron and carbon possesses properties of being able to be *hardened*, *tempered* and *annealed*.

When steel contains over ·25 per cent. carbon and not more than 1·5 per cent., it can be hardened by being suddenly quenched from a red heat.

Temper. The temper is judged by the colour of the film of oxide on a polished surface.

Oxide. Oxide is a combination of the oxygen in the atmosphere with the hot metal.

Anneal. To anneal is to soften by heating, followed by gradual cooling.

Harden. To harden carbon tool steel it must be brought to a bright red heat, and quenched in oil, water, etc.

Tempering Process. To temper bring the hardened steel to a temper, or to a proper degree of hardness, elasticity and toughness by re-heating.

HARDENING AND TEMPERING OF TOOLS

Hardening. Carbon steel tools are hardened by first heating to red heat (cherry red about 1700 degrees Fahrenheit) and then cooling suddenly. The hardness of the tool depends on the rapidity of the cooling, hence various cooling baths are used to obtain varying degrees of hardness. The order of the intensity of the hardening with various cooling baths, the most intense placed first, is as follows:

(1) Mercury.
(2) Brine (salt and water).
(3) Clean soft water.
(4) Soapy water.
(5) Milk.
(6) Oil.
(7) Tallow.
(8) Wax.

Clean soft water is suitable for most ordinary metal cutting tools.

Tempering. Hardened steel is too brittle for ordinary use, but it can be made elastic or less brittle by re-heating to a certain temperature, and cooling out in water. This process is known as tempering.

The common way of estimating temper is by means of the colour method by which the temper is gauged by the colour formed on the surface of the tool as its temperature rises.

If the face of the tool is brightened, and then heated, various colours appear on the brightened surface. First there is a faint yellow which blends into straw, followed by light brown, dark brown, purple, blue, dark blue, and green, with various intermediate shades.

For ordinary tools the temper of the *cutting edge* varies from straw to purple, depending on the quality of the steel and the material to be operated on.

Lathe tools, chisels, centre punches, etc., are commonly hardened and tempered by first heating the cutting end for a short distance to cherry red, then cooling out about half of the red portion, then quickly rubbing the tool with sandstone to brighten it. The heat remaining in an unquenched portion raises the temperature of the hardened edge until the required colour is obtained, after which the entire tool is quickly quenched.

NOTES ON PROCESSES

METHODS OF JOINING METALS

In all kinds of metalwork a knowledge of how metals may be joined together is essential. Joints are either permanent or temporary.

Permanent joints may be made by :

Burning.
Autogenous welding.
Welding by use of blacksmith's forge fire.
,, Oxy-acetylene.
,, Oxy-hydrogen.
,, Oxy-coal gas.
Brazing.
Silver soldering.
Soft soldering.
Folding.
Riveting.

Temporary joints.

Screwing.
Bolting.
Wedging.
Taper fitting.
Force fitting.
Shrink fitting.

In many cases though we call brazing, riveting, etc., permanent joints, they can with care be taken apart again.

The following table gives the names of some metals, the method of joining them and the flux necessary.

Name of Metal.	Soft Soldered.	
		Flux.
Aluminium	No	—
Aluminium bronze	Yes (after being coppered, see p. 20)	Zinc chloride or Sal ammoniac
Brass	Yes	,, ,,
Britannia metal	,,	,, ,,
Bronze	,,	,, ,,
Copper	,,	Zinc chloride, Sal ammoniac or Rosin
Delta metal	,,	,, ,,
Dutch metal	,,	,, ,,
German silver	,,	,, ,,
Gilding metal	,,	,, ,,
Gold	,,	,, ,,
Gunmetal	,,	,, ,,
Iron, galvanized	,,	Hydrochloric acid
Iron, wrought	,,	,, ,,
Iron, cast	Yes, not strong	Zinc chloride
Lead	Yes	Zinc chloride or Tallow, etc.
Manganeze bronze	,,	,, ,,
Mild steel	,,	,, ,,
Muntz metal	,,	,, ,,
Ormolu	,,	,, ,,
Pewter	Yes, but using special solder	Tallow or Gallipoli oil
Phosphor bronze	Yes	Zinc chloride or Sal ammoniac
Silver	,,	,, ,,
Tin	Yes, with care	,, ,,
Tinned plate	Yes	,, ,,
Tool steel	,,	,, ,,
Zinc	,,	Zinc chloride, Sal ammoniac or Hydrochloric acid

WHICH METALS MAY BE JOINED

Silver Soldered.		Brazed.		Autogenous Soldering or Burning, including Oxygen Acetylene Welding.		Welding Old Method by Smith's Fire.	
	Flux.		Flux.		Flux.		Flux.
No	—	No	—	Yes	None	No	—
Yes	Borax	Yes	Borax	No	—	,,	—
,,	,,	,,	,,	Yes	Borax	,,	—
No	—	No	—	No	—	,,	—
Yes	Borax	Yes	Borax	Yes	Borax	,,	—
,,	,,	,,	,,	,,	,,	,,	—
,,	,,	,,	,,	No	—	,,	—
,,	,,	,,	,,	,,	—	,,	—
,,	,,	,,	,,	,,	—	,,	—
,,	,,	,,	,,	,,	—	,,	—
,,	,,	No	—	,,	—	,,	—
,,	,,	Yes	Borax	Yes	Borax	,,	—
No	No	No	No	No	—	,,	—
,,	,,	Yes	Borax	Yes	None	Yes	Silver sand
,,	—	,,	Patent	,,	Borax	No	—
,,	—	,,	,,	,,	None	,,	—
Yes	Borax	,,	Borax	No	—	,,	—
,,	,,	,,	,,	Yes	None	Yes	Silver sand
,,	,,	,,	,,	No	—	No	—
,,	,,	,,	,,	Yes	Borax	,,	—
No	—	No	—	No	—	,,	—
Yes	No	Yes	Borax	,,	—	,,	—
,,	,,	No	—	,,	—	,,	—
No	—	,,	—	Yes	—	,,	—
,,	—	,,	—	No	—	,,	—
Yes	Borax	Yes	Borax	Yes	None	Yes	10 Borax, 1 Sal ammoniac or Borax and Venetian red
No	—	No	—	No	—	No	—

SOLDERING

There are three chief methods of soldering :

(1) Soft or lead soldering.
(2) Silver soldering or hard soldering.
(3) Brazing or spelter soldering.

SOFT SOLDERING

Soft or tinman's blowpipe solder is bought by the pound, and is in handy pieces ready for use. The best flux for use when soft soldering is ' killed spirits,' as it is called. To make this put some hydrochloric acid in a stoneware jar and add pieces of zinc. The acid will react and dissolve the zinc. Add zinc until all movement is finished, let it stand for 24 hours. Add 2 oz. of water to a pint of acid, allow to settle and strain through glass wool. It is now ready for use. It is most important that all joints should be thoroughly cleaned with a file, scraper or emery cloth before attempting to solder, otherwise the attempt will not be successful. There are many patent fluxes on the market which will answer the same purpose. But for general purposes killed spirit is the best, providing that you wash the joint well afterwards in water or water with soda added.

After cleaning the metals to be soft soldered they should be held together and a small quantity of flux applied. The joint should now be heated by blowpipe or soldering iron, and a small quantity of solder applied, when the solder should melt easily and run into the joint, so ' sweating ' the joint together.

When using the ' soldering iron ' or ' copper bit,' as it is called, care must be taken not to overheat it.

If the point is not clean and silvery-looking the iron must be heated, filed up clean, then dipped in spirits and rubbed on or in some solder. The point should now look very white and bright, in which case it is ready for use.

SILVER SOLDERING

Silver solder can be bought in sheet or wire form, and it will not run without the use of a suitable flux. The flux is made by mixing powdered borax with water. This is applied to the joint, which must be cleaned by filing or scraping. Tie the

job together with iron wire and heat carefully to a full red heat. Apply a small amount of silver solder, when it should run or flow neatly into the joint. Small pieces of solder can be placed along the join and if the heat is applied gently at first these will not jump off.

The job should now be put into weak pickle until all the borax has been dissolved away from the joint.

BRAZING

Spelter for brazing is bought by the pound, and it is in fine grains. Brass or brazing wire can be used for iron or steel.

The surfaces of the joint should be filed clean and flux applied, and then the job tied together with iron wire. The flux is borax and water as for silver soldering. The flux and spelter are next placed along the joint and heat applied until the spelter runs evenly along, and also through the joint.

Sometimes difficulty is experienced in getting the spelter to flow evenly. This is overcome by assisting the molten metal to flow with a piece of pointed wire $\frac{3}{16}''$ diameter and at the same time scratching the stubborn parts with the point. The work must be heated to a bright red heat.

Be sure your spelter melts before the job.

A blowpipe flame is necessary for small jobs, and a forge or coke fire for large work.

After being brazed the work should be put into pickle until all the borax has been dissolved.

THE PROGRESSIVE USE OF THE LATHE

The most suitable lathe for young boys to use is a plain single speed lathe which can be used with or without mechanical power.

Simple work, such as drilling holes or turning small knobs of all kinds for use on woodwork jobs, is really good as an introduction to the use of a lathe. Other suitable exercises include the turning of handles for the scraper sharpener and tack-lifter illustrated on page 26. (These handles should be fitted with ferrules), bails for cricket sets and knobs for chests of drawers. Wood mallets and dumb bells.

The wood handle for the garden rake illustrated on page 104, and drumsticks (made of hardwood) are also good exercises.

Following this may come the small knobs for the end of the toasting fork shown on page 34, which are roughed out and then finished with a forming tool.

After this the small feet used on the teapot stand (page 96) are suitable examples, and then larger work in such metals as brass or gunmetal may be introduced. (*N.B.* Brass serviette ring on page 30 and candlestick illustrated on page 90.)

After some practice, a lathe with screw-cutting attachments may be used, when the harder metals may be turned.

Commence with simple parallel and simple taper pins, tap wrenches and bolts, and then proceed to what is known as turning between centres, face-plate work, and chuck work. Gradually increase the difficulty of the work by insisting on working to fine limits, and so proceed to make the various tools that are used in a workshop.

METHOD OF WORKING WITH PITCH

To make up and use pitch satisfactorily there are certain factors which ensure success. They are as follows :

Use brown Swedish pitch.

Mix it up approximately as follows :

Pitch - - - - -	7 lbs.
Common Plaster of Paris - -	7 lbs.
Tallow - - - - -	½ lb.

Melt the pitch until liquid and add the tallow. Then add the plaster of Paris a little at a time, and stir it well.

In hot weather add more plaster of Paris to harden the mixture.

In cold weather add more tallow to soften it.

To Prepare the Work. Give the job a coating of grease. Then pour some pitch in or over the job leaving it to set. When set give the pitch block a coat of liquid pitch, and give the job another coating of liquid pitch. Now stick the job on the pitch and put a weight on the job to press out the air. Do not work on this until the pitch is set.

To remove the work from the pitch warm it gently and lift it off with a piece of wood or the tongs. Be careful not to overheat the work and so burn the pitch.

If the pitch gets burnt on to the metal the only thing to do is to anneal the job all over.

To clean the work of pitch the best method is to warm it gently, sprinkle oil and sawdust all over it and wipe it off with a rag or some cotton waste.

RECIPES FOR CLEANING AND FINISHING METAL SURFACES

1. A bright dip for cleaning brass, gunmetal and copper.

Nitric acid	-	2 parts.
Sulphuric acid	-	1 part.

Hydrochloric acid $\frac{1}{2}$ pint to every gallon of the mixture as above.

2. Pickle for cleaning brass, copper and gunmetal.

To every gallon of the above bright dip add 2 gallons of water.

3. Pickle for cleaning iron or steel.

Sulphuric acid	-	1 part.
Water	- - -	4 parts.

To avoid accidents the sulphuric acid should always be added to the water, slowly pouring the acid down the side of the vessel containing the water.

4. To colour brass and copper various shades, light brown to black.

$\frac{1}{4}$ oz. of potassium sulphide to one gallon of boiling water. The colour can be altered by rubbing the job over with clean fine silver sand and water.

To colour brass or aluminium bronze red, wrap iron wire all round the article and dip it in a strong solution of copper sulphate and water, or dip it in pickle.

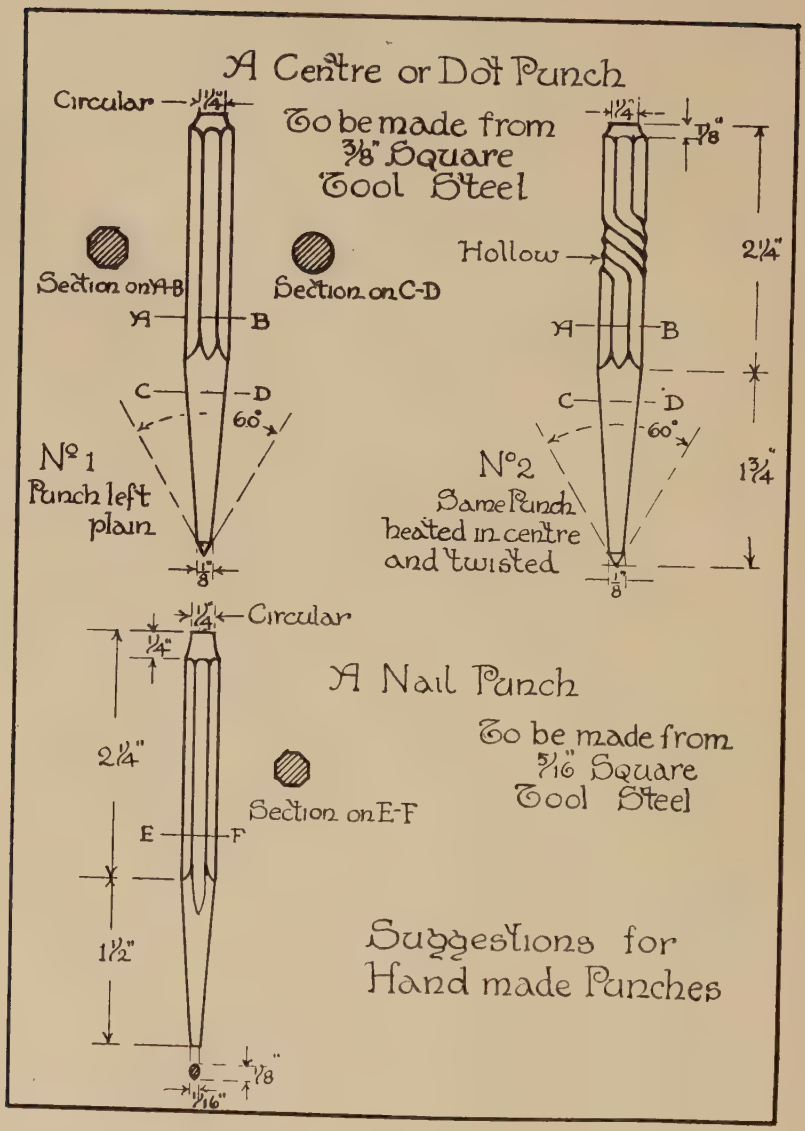
5. Lacquering.

Wipe the work clean with a duster. Wash in methylated spirits and dry. Warm slightly and dip in Fridgilene. Dry in a warm place.

III

A GRADED COURSE OF MODELS

PLATE I



Suggestions for
Hand made Punches

A CENTRE PUNCH

Method of Procedure

1. Obtain a short length of material, heat one end in the forge and hammer down to size and shape with hammer on the anvil.

2. Cut off to length.

3. File up to correct size and shape, using bastard and smooth files.

4. Harden point right out.

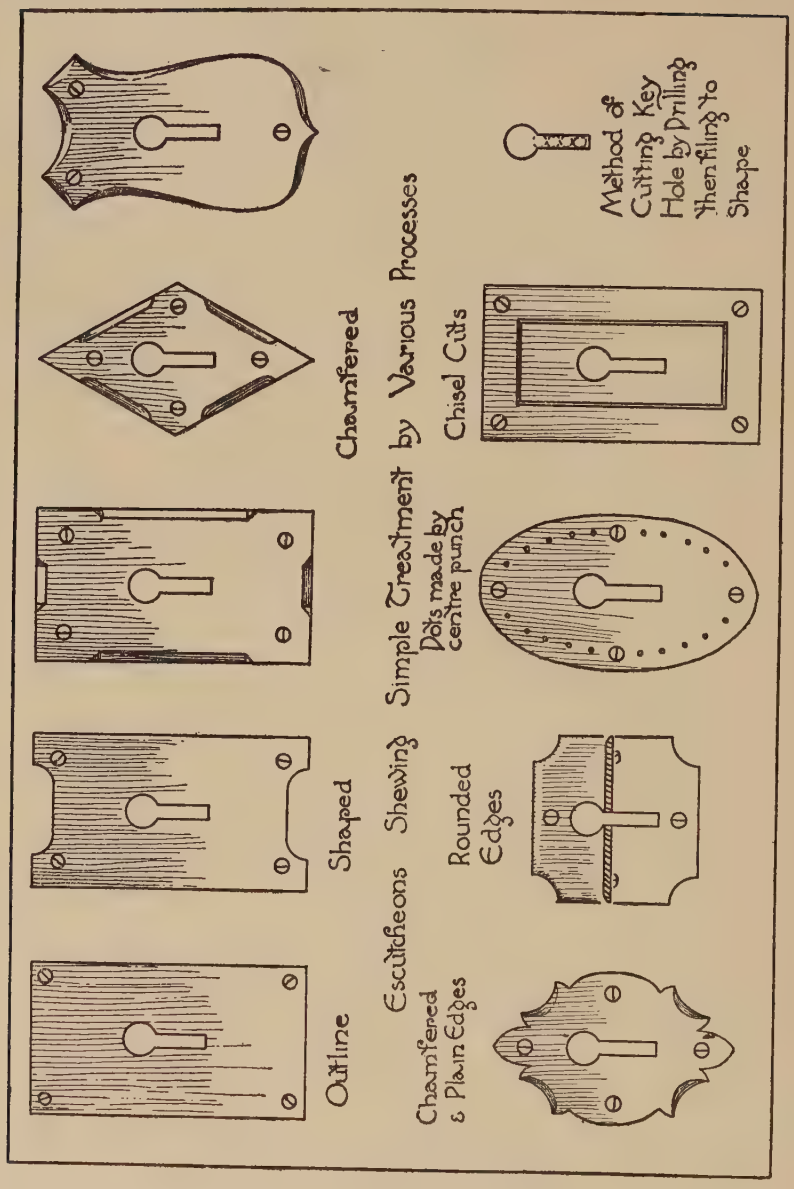
5. Polish up pointed or tool end with emery cloth or on a wet grindstone.

6. Temper tool end to a dark brown colour.

NOTE. For hardening and tempering tools see page 12.

This exercise should be preceded by a short talk on metals which should include some information on tool steel.

PLATE II


Escutcheons
Outline
Shaped
Shewing
Rounded
Edges
Chamfered
& Plain Edges
Simple Treatment by Various Processes
Dots made by centre punch
Chisel Cuts
Chamfered
Method of Cutting Key Hole by Drilling then Filing to Shape

ESCUTCHEONS

Method of Procedure

1. Obtain a piece of No. 14 or No. 16 I.S.W.G. metal.

2. Transfer drawing of escutcheon to the metal and scribe it in.

3. Cut out with small chisels and hammer.

4. File up to shape with bastard and smooth files.

5. Drill holes for screws and drill out keyhole.

6. Trim off the burrs and file keyhole to shape.

7. Hold the escutcheon on a flat piece of wood by means of 4 or 6 pins placed round the edges.

8. Face up with bastard and smooth files.

9. Chamfer where necessary, then add any decorative features required.

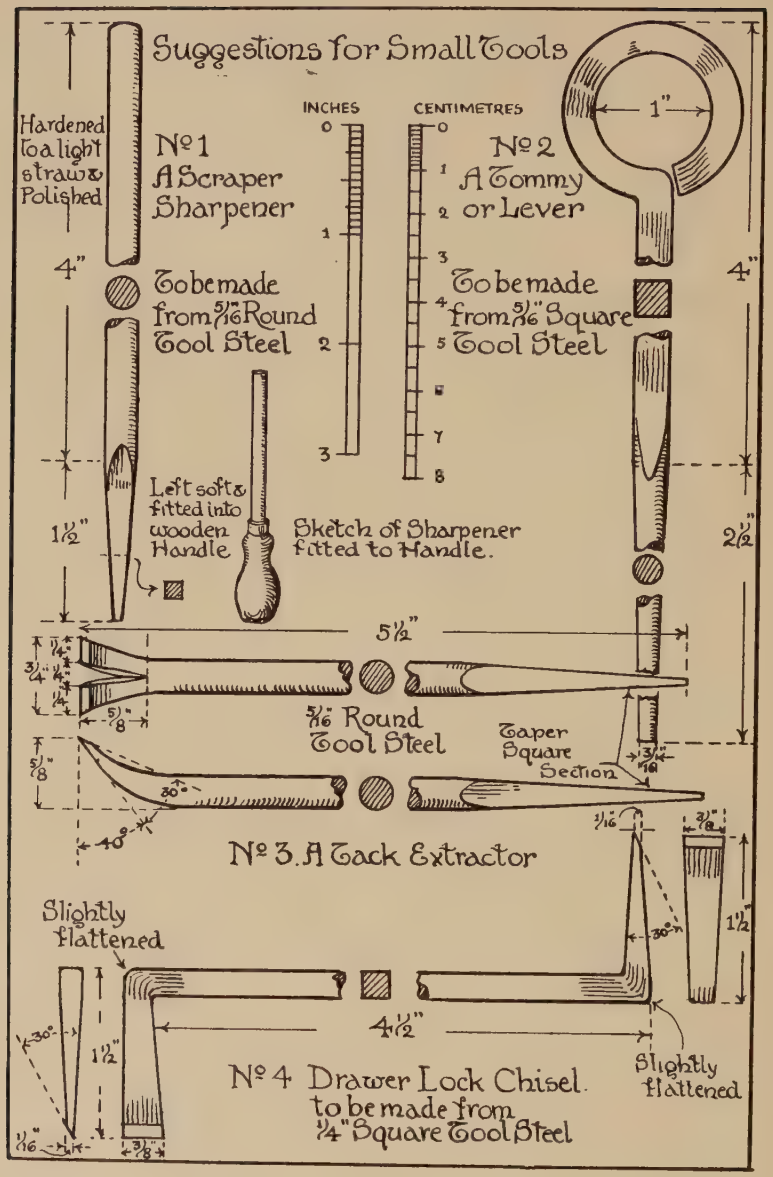
10. Polish or stain, and lacquer as required.

For another example, see page 76.

NOTE. When setting the above escutcheons out, a half templet is a good means of obtaining both sides alike. These escutcheons could also be cut out with a fret saw, but this method requires more skill.

A lesson or a short talk on Alloys should be given in conjunction with these escutcheons (see pages 7, 8, 9).

PLATE III


Suggestions for Small Tools
Hardened to a light straw & Polished
4"
1½"
No 1
A Scraper Sharpener
To be made from 5/16 Round Tool Steel
INCHES
CENTIMETRES
Left soft & fitted into wooden Handle
Sketch of Sharpener fitted to Handle.
No 2
A Tommy or Lever
1"
To be made from 5/16" Square Tool Steel
4"
2½"
5½"
3/4"
1/4"
5/8"
5/16 Round Tool Steel
Taper Square Section
3/16"
30°
No 3. A Tack Extractor
1/16"
3/8"
1½"
Slightly flattened
4½"
No 4 Drawer Lock Chisel.
to be made from
1/4" Square Tool Steel
Slightly flattened

SMALL TOOLS

A Scraper Sharpener—No. 1

Method of Procedure

1. Obtain a convenient length of tool steel, heat one end to a bright red heat in the forge fire and hammer down the tang to a square point.

2. Cut off to length.

3. File up to shape.

4. Harden all out.

5. Clean up all over with emery cloth.

6. Temper to a light brown.

7. Soften the tang.

8. Heat tang and drive into the wood handle.

Continue lesson on Tool Steel (see page 11).

A Tommy or Lever—No. 2

Method of Procedure

1. Obtain a convenient length of material, heat one end and draw down to a round point.

2. Measure off correct distance for bend and dot with a centre punch.

3. Heat at dot mark to a bright red, place in vice and hammer up the material to a sharp right-angle bend.

4. Measure off distance for eye or ring and cut off, and square the end with a file.

5. Bend up the eye as shown on page 34.

6. File up all over, cut off surplus and finish off with a smooth file.

Note. To obtain correct length of material required for forging curved work, measure a hypothetical curve midway between the outer and inner curves.

A Tack Extractor—No. 3

Method of Procedure

1. Obtain a convenient length of tool steel, heat one end to a bright red and draw down to a square point.

2. Cut off to length.

3. Heat the thick end and hammer out to required width.

4. Heat end again and split it with a chisel.

5. File up to correct size and shape, and see that the bevels are correct.

6. Heat the split end and bend it up to the correct curve.

7. Heat the forked end and harden it.

8. Clean up all over with emery cloth, then temper forked end to a very dark colour,—nearly purple.

A Drawer Lock Chisel—No. 4

Method of Procedure

1. Obtain a convenient length of material, heat one end and draw down to shape on the anvil.

2. Cut off to length.

3. Centre dot position of each angle.

4. Draw down the opposite end to required thickness.

5. Heat portion where marked to a bright red, place in vice and hammer up to a right angle. Reheat and slightly hammer down the corner.

6. Repeat on opposite angle and see that it is bent on the correct side.

7. File up to correct sizes and shapes, using rough and smooth files.

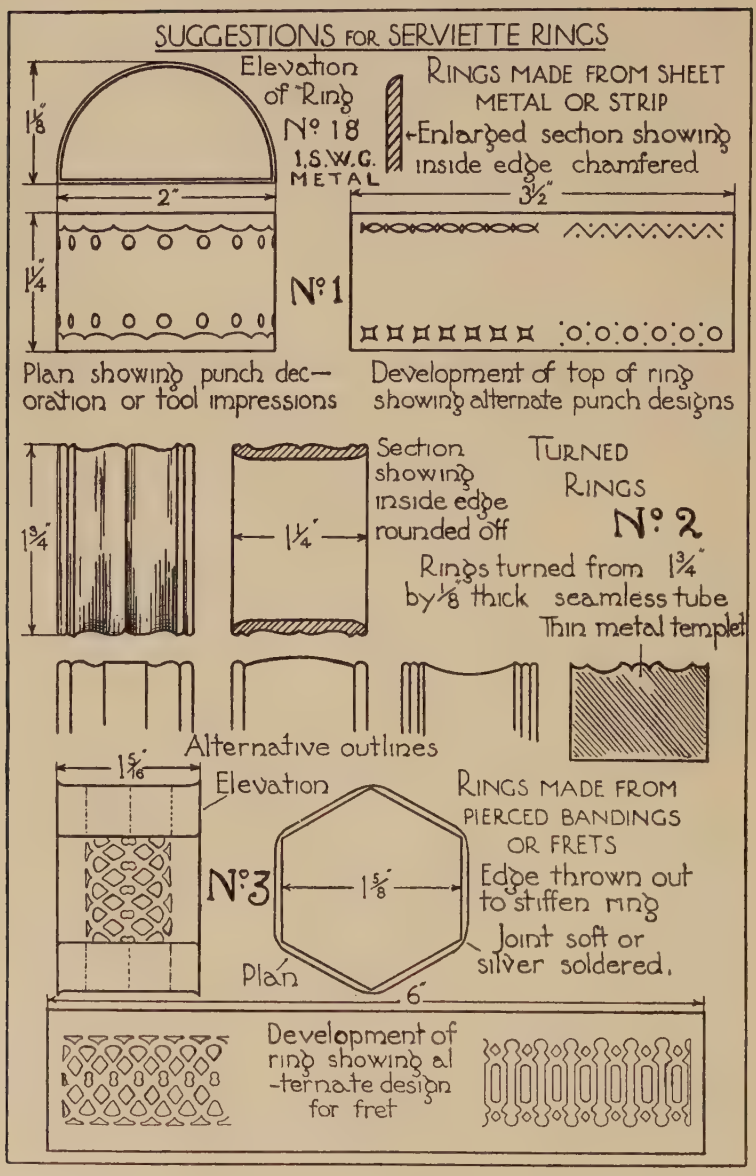
8. Harden each end in turn.

9. Clean up ends on wet grindstone.

10. Temper each cutting end to a light brown colour.

11. Sharpen each cutting end on the oilstone.

PLATE IV


SUGGESTIONS FOR SERVIETTE RINGS
Elevation of Ring
No 18
1.S.W.G. METAL
1⅛"
2"
1¼"
RINGS MADE FROM SHEET METAL OR STRIP
←Enlarged section showing inside edge chamfered
3½"
No 1
Plan showing punch decoration or tool impressions
Development of top of ring showing alternate punch designs
1¾"
1¼"
Section showing inside edge rounded off
TURNED RINGS
No 2
Rings turned from 1¾" by ⅛" thick seamless tube
Thin metal templet
Alternative outlines
1⅝"
Elevation
No 3
1⅝"
Plan
RINGS MADE FROM PIERCED BANDINGS OR FRETS
Edge thrown out to stiffen ring
Joint soft or silver soldered.
6"
Development of ring showing alternate design for fret

SERVIETTE RINGS

A Half-round Serviette Ring—No. 1

Method of Procedure

1. Cut out the base. Set out the development for top portion of ring and cut it out of No. 18 I.S.W.G. metal.

2. Flatten them on a surface plate with a flatter and trim the edges up square and to the correct sizes.

3. Set out the design on the top portion and punch it in, laying the metal on a surface plate.

4. Flatten the metal on the reverse side, using a flatter. Round the inside of top and bottom edges with a file.

5. Bend up top portion to the correct shape and fit it neatly to the base.

6. Fix the two pieces together either by brazing, silver soldering or soft soldering.

7. Clean off solder from joint and polish up in the usual manner.

It can now be lacquered or silver plated.

A Turned Serviette Ring—No. 2

Method of Procedure

1. Make a thin metal templet to the outline of ring.

2. Cut off the ring from a piece of thick tube by ' parting off ' in the lathe, or cutting it off with a hacksaw.

3. Place in a three-jawed chuck in the lathe and face off one end and round out the inside edge.
Reverse ring and repeat the operation as shown in the drawing.

4. Turn a boxwood mandrel on to which the ring will fit tightly.

5. Drive the metal ring on to the mandrel, place mandrel in the lathe and see the ring runs truly, without any ' wobble.'

6. Turn to shape, occasionally checking the outline with the templet.

7. Finish off with very fine emery cloth wrapped round a small half-round file, and finally use jewellers' No. 00, No. 000, and No. 0000 blue-backed emery paper to bring the job to a high polish.

8. Remove from mandrel; if there is any difficulty, warm the job and it will fall off owing to expansion.

9. This could now be lacquered or silver-plated.

No. 3

Method of Procedure

1. Set out development of ring and cut banding off to the correct length, taking care that the pattern will match at the joint.

2. Flatten gently so that the banding does not stretch unevenly and mark it off into six divisions.

3. Line the angles strongly with a lining tool on a lead block, or on a flat piece of wood.

4. Bend up to a true hexagon and tie the ends together neatly with iron binding wire.

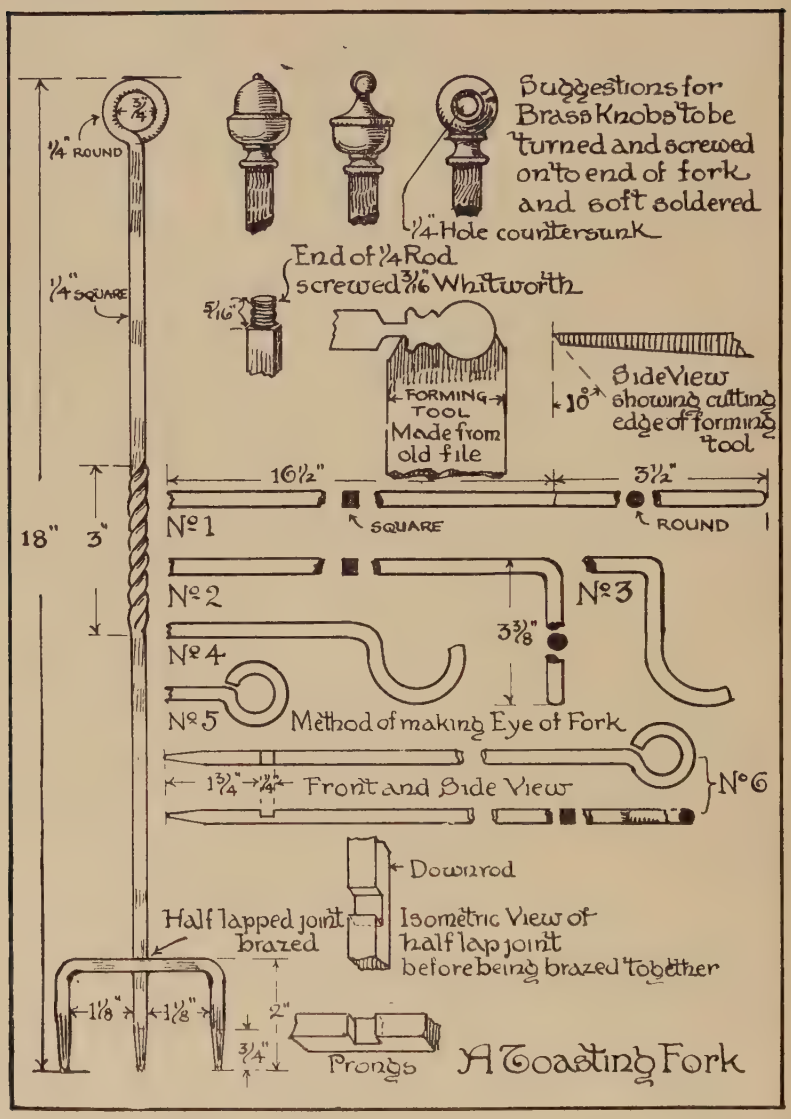
5. Silver solder the joint together. (It could be brazed or soft soldered.)

6. Place the ring on a mandrel and tap it all over with a light hammer, and make it a true hexagon. Then hammer out the edges as shown. This will stiffen the ring.

7. Polish in the usual manner or have it silver-plated.

NOTE. The fret or pierced banding used for this ring can be bought in any length and in many different widths and designs. See page 114.

PLATE V


Suggestions for Brass Knobs to be turned and screwed on to end of fork and soft soldered
¼" Hole countersunk
End of ¼ Rod screwed 3/16 Whitworth
5/16"
¼" ROUND
¼" SQUARE
FORMING TOOL Made from old file
Side View showing cutting edge of forming tool
10°
18"
3"
16½"
3½"
№1
SQUARE
ROUND
№2
№3
№4
3 3/8"
№5
Method of making Eye of Fork
1¾"
¼"
Front and Side View
№6
Down rod
Half lapped joint brazed
Isometric View of half lap joint before being brazed together
1⅛"
1⅛"
2"
¾"
Prongs
A Toasting Fork

TOASTING FORK

Method of Procedure

1. Obtain 22″ of $\frac{1}{4}$″ sq. mild steel.

2. Heat one end to a bright red heat, and hammer to a circular section on the anvil.

3. Heat rod about 4″ from rounded end and bend to a right angle, using the vice, and then hammer the rod to sharpen the angle.

4. Reheat and bend up the eye as illustrated.

5. Make the prongs from $\frac{1}{4}$″ sq. by forging the points or filing them.

6. Mark centre rod for position of prongs, then make and fit the half-lapped joint.

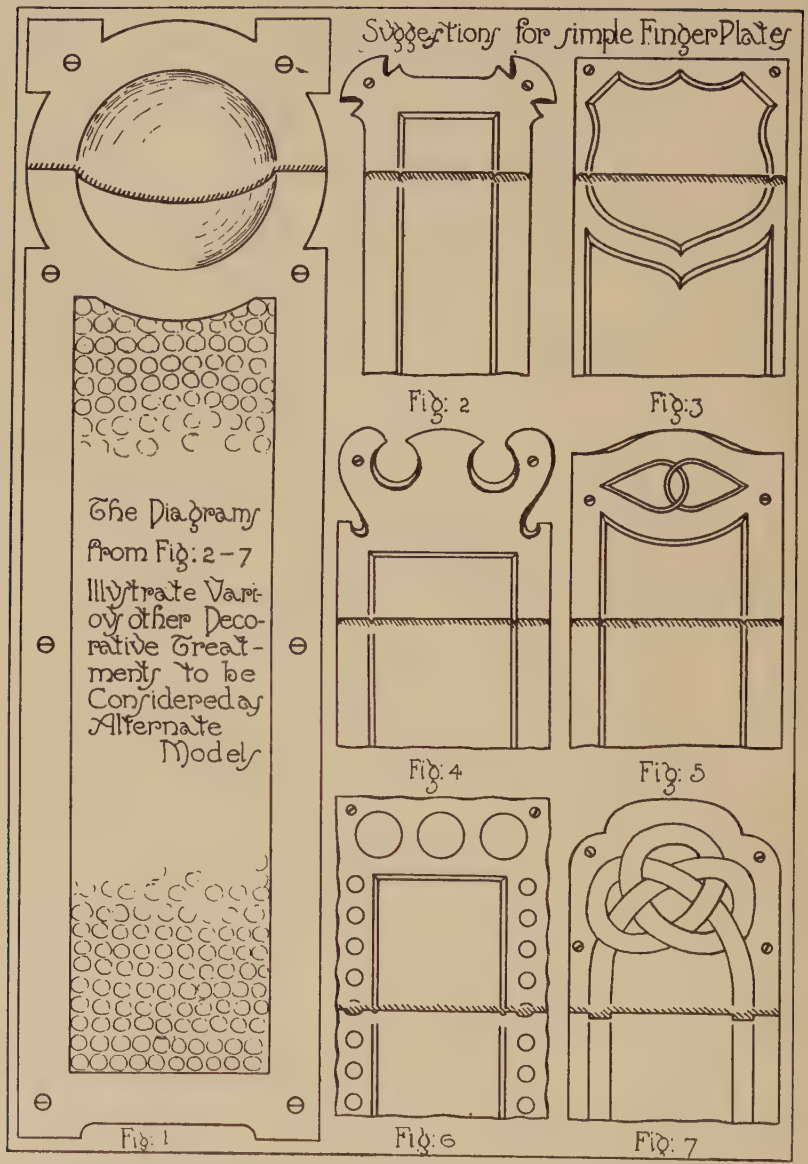
7. Twist centre portion, using a tap wrench; length of twist is decided by distance between portion held in vice and tap wrench.

8. Tie prongs to centre rod with iron binding wire and braze together, using brass wire and borax as a flux.

9. Clean off surplus metal and finish up with a smooth file. Then give a coating of oil.

NOTE. If the turned knobs are used, the end of centre rod would be filed round in section and a shoulder formed and then screwed with the stocks and dies. The knobs would be turned, drilled and tapped. For size of hole to drill see page 113.

A short talk on Forge Tools should precede the above.


Suggestions for simple Finger Plates
The Diagrams from Fig: 2–7 Illustrate Various other Decorative Treatments to be Considered as Alternate Models
Fig: 1
Fig: 2
Fig: 3
Fig: 4
Fig: 5
Fig: 6
Fig: 7

FINGER PLATES

No. 1

Method of Procedure

1. Cut off a piece of metal $10\frac{1}{4}'' \times 2\frac{3}{4}''$ of No. 16 I.S.W.G. (Cut it carefully to correct size.)

2. True up, and square all the edges with bastard and smooth files (holding the plate between two pieces of wood in the vice).

3. Mark out the design with a steel scriber, then cut out and file up the outline.

4. Go over the outline of circle and panel with a lining tool of the correct thickness. For method of using lining tool see page 42.

5. Hammer up the boss on a lead block, then planish it on a ball-head stake with a hammer that has a polished face.

6. Lay plate on a smooth and flat piece of iron and mark centre panel with a round-face punch.

7. Flatten plate with a boxwood mallet then with a flatter, taking care not to mark the plate.

8. Go over the lines again with the lining tool, making them as true as possible, then finish off edges of plate with a smooth file. Centre dot and drill $\frac{1}{8}''$ fixing holes.

9. Clean surface of plate with fine emery cloth and oil, and finish off with polishing paste.

10. Wipe off all grease with a clean duster, wash in methylated spirit, then dip in cold lacquer. Hold it with wire and hang up to dry in a warm and dustless place.

Nos. 2, 4 and 5

Method of Procedure

1. Make drawing of finger plate to the correct size and take off this a tracing. Then by means of carbon transfer paper, transfer tracing of plate on to a piece of metal.

2. Mark out the design on the metal with a steel scriber, and ensure that both ends of the plate are alike, for Fig. 2.

3. Cut out the plate with small chisels or with a fret saw.

4. File up the edges of plate to the correct shape and chamfer with small smooth files.

5. Line in the panel or ornament where necessary with a lining tool. Centre dot fixing holes. (This must be done on a flat piece of iron.)

6. Flatten plate very carefully from both sides. Lay plate on a thick piece of wood, hold wood in vice, and fix plate by the edges to the piece of wood, using strong pins. Drill fixing holes.

7. Face up the plate, using bastard and smooth files. (Tap the hollows up from the back.) Finish off plate with No. 0 emery cloth wrapped round a file.

8. Go over the edges of the plate with a smooth file and touch up the chamfers.

9. Polish plate with polishing paste. Wipe over with a clean duster and give a coating of colourless lacquer.

No. 3

Method of Procedure

1. Cut off a piece of metal to the correct size, flatten it with a mallet or boxwood punch.

2. Hold it between two pieces of wood in the vice, and true up one edge with bastard and smooth files.

3. True up the opposite edge parallel with it, then square the ends.

4. Mark out the design, using a steel scriber.

5. Line in the design with a lining tool. (This must be done on a flat piece of iron.)

6. Flatten plate carefully from both sides, and set out and centre dot fixing holes.

7. Fix on a piece of wood, and face up with bastard and smooth files. Drill fixing holes

8. Touch up the engraved lines with the point of a 3″ or 4″ half-round smooth file.

9. Polish plate and give a coating of colourless lacquer.

Nos. 6 and 7

Method of Procedure

1. Obtain a piece of No. 22 I.S.W.G. metal $\frac{1}{2}$″ larger all the way round than the finished plate. Clean the surface with fine emery cloth and wipe clean.

2. Transfer drawing of finger plate by means of tracing and carbon papers to the metal, and then line in design with a steel scriber.

3. Grease back of plate, warm slightly, and stick it on a bed of pitch (see page 19). Leave to get quite cold and hard.

4. Model up the design with repoussé punches to the sections shown on drawing. Remove from pitch block, clean and stick it down again the reverse way.

5. Smooth away any irregularities on the front, and leave all modelling smooth and well defined.

6. Remove plate from pitch, clean all pitch off, leaving plate thoroughly clean. Lay plate on a smooth and flat piece of iron and flatten it with boxwood and steel punches.

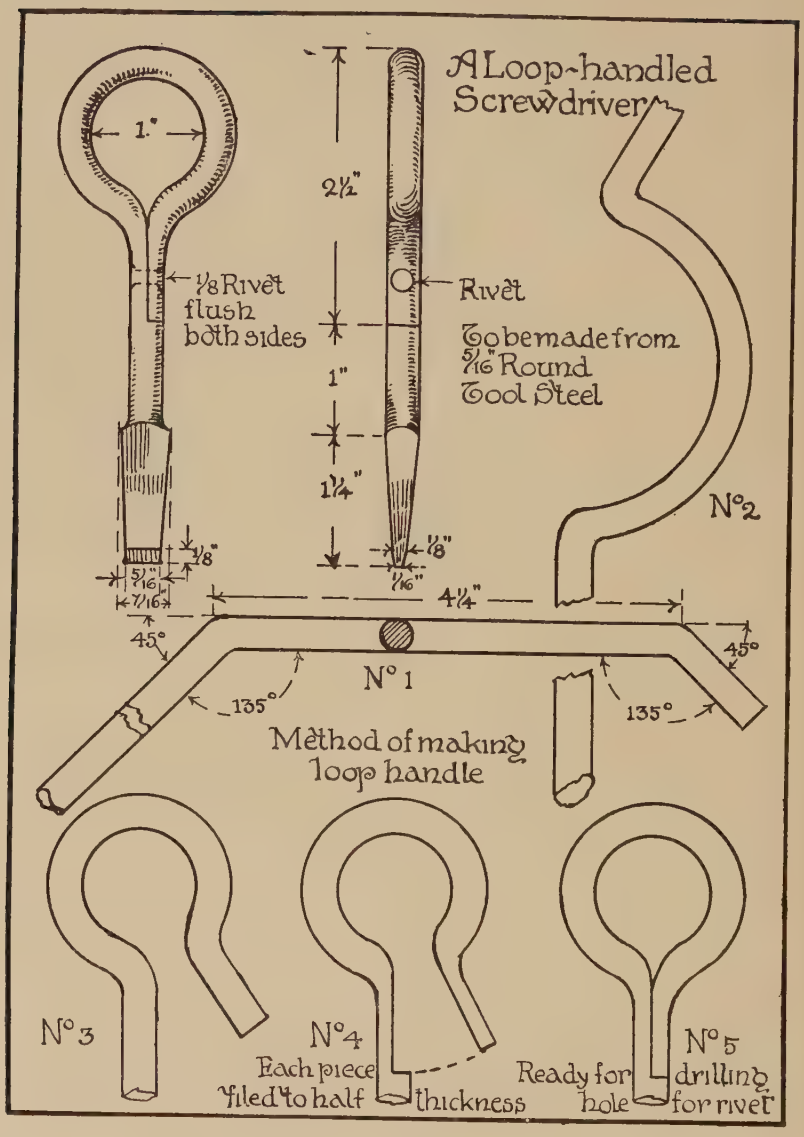
7. Cut the plate out with shears or fretsaw, flatten and file up the edges true and smooth.

8. Finish up plate to an even colour with emery cloth and oil.

9. Polish with polishing paste and wipe off all grease with a clean duster and whiting or Sheffield lime.

Note. If plate is required to be coloured proceed as stated on page 20.

PLATE VII


A Loop-handled Screwdriver
1"
2½"
⅛ Rivet flush both sides
Rivet
To be made from 5/16" Round Tool Steel
1"
1¼"
N° 2
⅛"
5/16"
7/16"
⅛"
5/16"
4¼"
45°
45°
N° 1
135°
135°
Method of making loop handle
N° 3
N° 4
Each piece filed to half thickness
Ready for hole
N° 5
drilling for rivet

LOOP-HANDLED SCREWDRIVER

Method of Procedure

1. Cut off 8″ of $\frac{5}{16}$″ round tool steel.

2. Bend up the handle as shown in drawings Nos. 1, 2, 3.

3. Then reheat and bend it tightly round a piece of 1″ round iron, pinching the ends in a vice.

4. Hammer out the blade.

5. Twist part of handle to one side and file the half-lap joint.

6. Straighten handle and test fitting as sketch No. 4. If correct close up as No. 5.

7. Anneal screwdriver ready for drilling.

8. Dot the centres, drill and countersink hole both sides.

9. Rivet handle together.

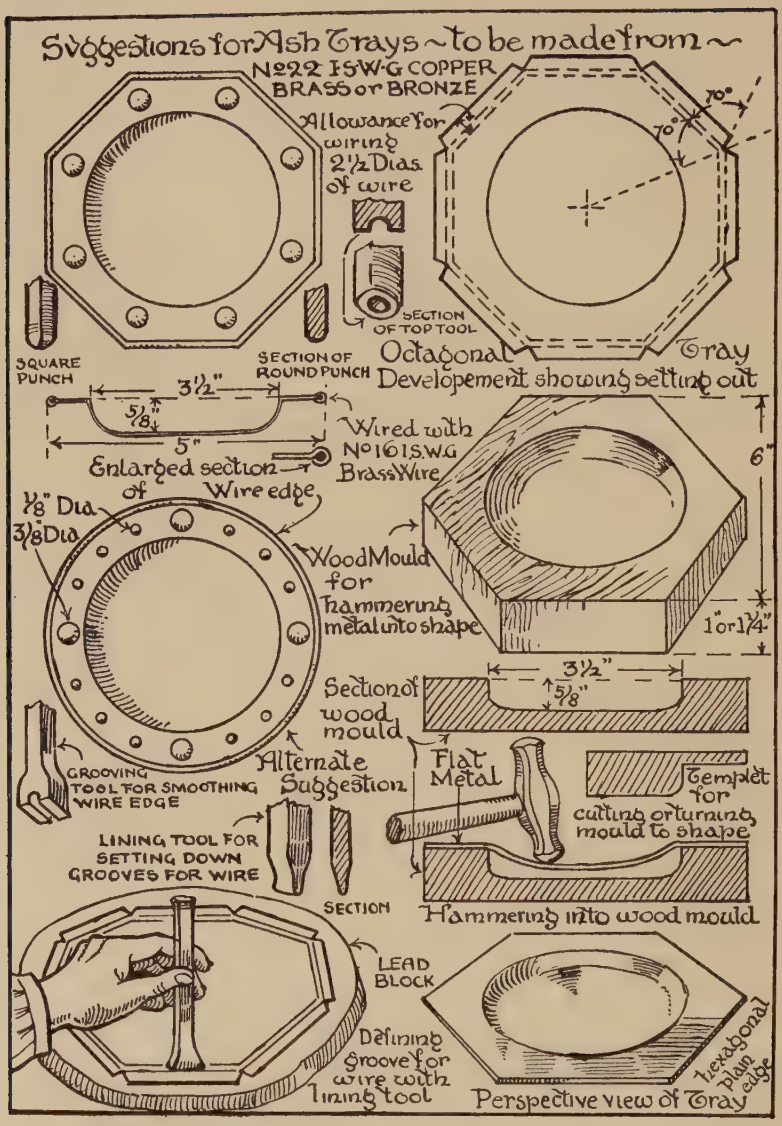
10. File up blade exact to size and shape and finish off.

11. Harden and temper blade to a dark brown colour (nearly purple).

12. Clean up all over with No. 1 emery cloth.

NOTE. A small flat surface about $\frac{3}{4}$″ long could be filed on handle to allow for initials to be stamped on the ' flat ' so formed.

PLATE VIII


Suggestions for Ash Trays ~ to be made from ~
No 22 I.S.W.G COPPER
BRASS or BRONZE
Allowance for wiring 2½ Dias of wire
SECTION OF TOP TOOL
70°
70°
SQUARE PUNCH
SECTION OF ROUND PUNCH
Octagonal Tray
Developement showing setting out
3½"
⅝"
5"
Wired with No 16 I.S.W.G Brass Wire
Enlarged section of Wire edge
⅛" Dia
⅜ Dia
Wood Mould for hammering metal into shape
6"
1" or 1¼"
3½"
⅝"
Section of wood mould
Alternate Suggestion
Flat Metal
Templet for cutting or turning mould to shape
GROOVING TOOL FOR SMOOTHING WIRE EDGE
LINING TOOL FOR SETTING DOWN GROOVES FOR WIRE
SECTION
Hammering into wood mould
LEAD BLOCK
Defining Groove for wire with lining tool
Perspective view of Tray
Hexagonal plain edge

AN OCTAGONAL ASHTRAY

MADE FROM BRASS, COPPER, OR GILDING METAL.

Method of Procedure for Hexagonal Tray.

1. Cut out a piece of metal No. 22 I.S.W.G. $5\frac{1}{2}''$ square.

2. Mark out $5''$ square, draw diagonals, $3\frac{1}{2}''$ circle, and inscribe octagon in the square. Add line for lap. (Lap for wire $= 2\frac{1}{2}$ times D. D = diameter of wire used.)

3. Make a thin metal templet for shape and depth of hollow (see sketch).

4. Make a wood block $6\frac{1}{2}'' \times 1\frac{1}{4}''$ and sink a hollow in the centre, working to the templet.

5. Slowly revolve the metal and gradually hammer the metal into the hollow of the wood block.

6. Flatten edges or flange with flat punches on a smooth piece of iron or wood.

7. Get lining tool and make a deep groove for the wire on a lead block, then turn up remainder of metal at right angles to flange.

8. Obtain a piece of wire and fit it neatly to the groove, the joint to come in the centre of a long side. (Not at the corner.)

9. Hammer metal over the wire and smooth down with grooving tool on the face side.

10. Smooth tray up all over with punches and hammer.

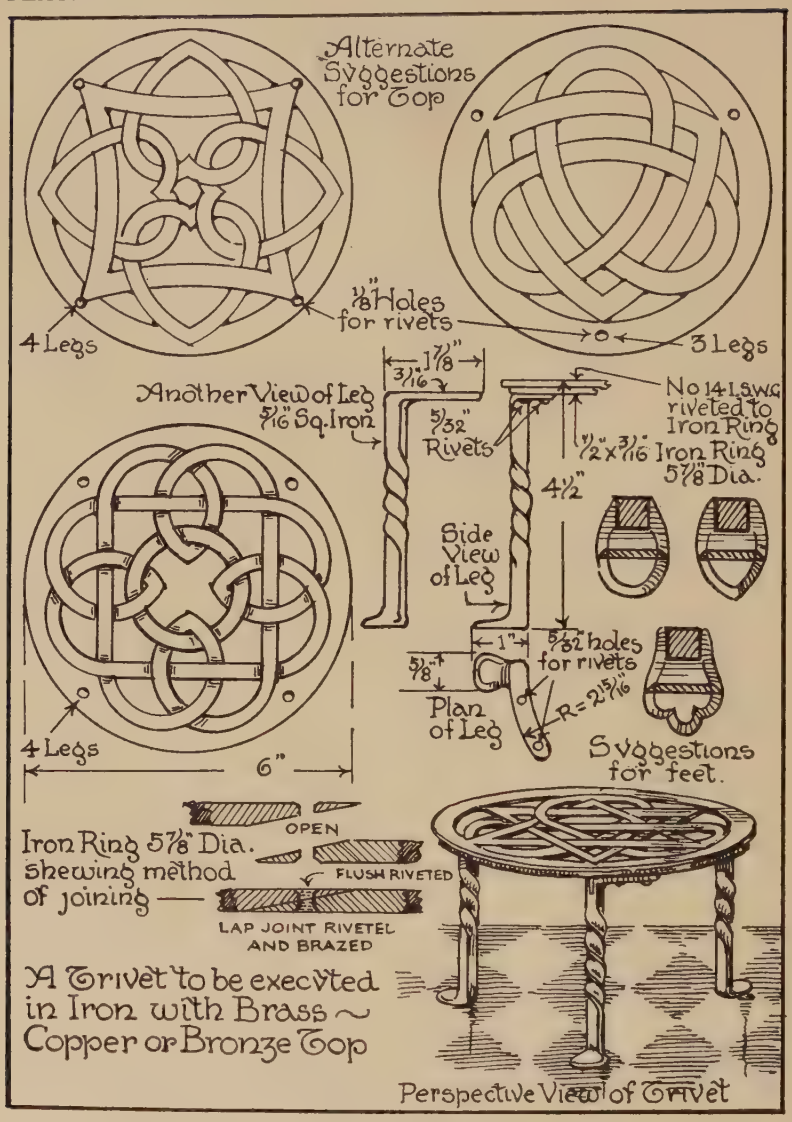
11. Mark position of bosses, grease all over, and stick tray on pitch block (or lay tray on lead block, seeing beaded edge is clear of block).

12. Raise bosses with punches, then set down bosses with hollow tools, on the face side.

13. Clean up all over with emery cloth and oil. Finish off with polishing paste and whiting.

NOTE. The Circular Tray is made in practically the same way, so that it is not necessary to repeat method of procedure. The hexagon tray at the bottom right-hand side is made of No. 18 I.S.W.G. material, and the edges are rounded with a file, so forming a simpler model.

PLATE IX


Alternate Suggestions for Top
4 Legs
1/8" Holes for rivets
3 Legs
Another View of Leg 5/16" Sq. Iron
1 7/8"
3 1/16"
5/32" Rivets
No 14 S.W.G. riveted to Iron Ring
1/2" x 3/16" Iron Ring 5 7/8" Dia.
4 1/2"
Side View of Leg
1"
5/32" holes for rivets
5/8"
R = 2 15/16
Plan of Leg
Suggestions for feet.
4 Legs
6"
OPEN
Iron Ring 5 7/8" Dia. shewing method of joining
FLUSH RIVETED
LAP JOINT RIVETED AND BRAZED
A Trivet to be executed in Iron with Brass ~ Copper or Bronze Top
Perspective View of Trivet

TRIVET OR FOOTMAN

Method of Procedure

1. Obtain a short length of $\frac{1}{2}'' \times \frac{3}{16}''$ mild steel and bend up to form a ring to which feet are later riveted.

2. Scarf, rivet, and braze the joint.

3. Forge the feet, bend up return piece, make the twist in centre of leg. Legs to be made from $\frac{5}{16}''$ square mild steel. For method of twisting centre of legs see page 74.

4. Make templet of foot, and mark out shape on feet. Then file them up to the correct size and shape.

5. Mark, centre dot and drill $\frac{5}{32}''$ holes in legs. Slightly countersink under sides of holes.

6. Mark off position of holes on ring, using legs as templet. Centre dot, drill and countersink $\frac{5}{32}''$ holes.

7. Rivet legs to ring and set the legs all square and upright.

8. Transfer design of top to No. 14 I.S.W.G. metal, then scribe in design with a steel scriber.

9. Cut out the design by drilling, chiselling and filing, or cut out design with a fretsaw.

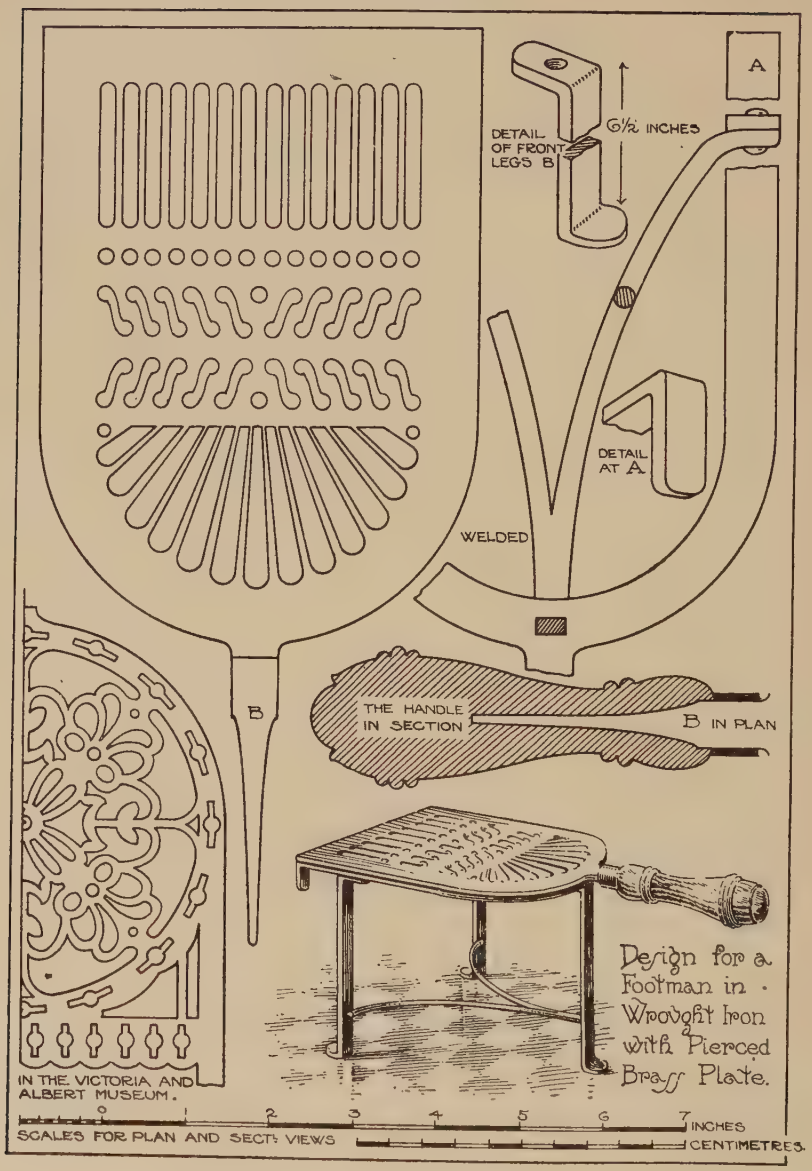
10. Make a wood block $6'' \times 6'' \times 1''$ with a $2'' \times 1'' \times 6''$ fillet screwed in the centre. Flatten the metal top of trivet and pin it to the wood block. Hold wood block in the vice and face up the metal with bastard and smooth files, finishing off with emery cloth. If copper is being used, finish off with pumice stone and water.

11. Fit metal top to iron ring. Mark positions of holes, centre dot and drill them, remove burr and slightly countersink top side of holes. Mark position of holes on iron ring whilst holding top plate in position ; centre dot, drill and countersink holes on under side of ring.

12. Fit rivets and cut to correct length, then rivet top plate to iron ring. Hold head of rivet in a cup tool to prevent flattening of head of rivet.

13. Polish top with fine emery cloth and oil, give ironwork a coating of a dead black paint. Finish polishing top with polishing paste and then wipe top up with a clean duster.

PLATE X


A
DETAIL OF FRONT LEGS B
6½ INCHES
DETAIL AT A
WELDED
B
THE HANDLE IN SECTION
B IN PLAN
IN THE VICTORIA AND ALBERT MUSEUM.
Design for a Footman in Wrought Iron with Pierced Brass Plate.
0 1 2 3 4 5 6 7 INCHES
SCALES FOR PLAN AND SECTN VIEWS
CENTIMETRES.

TRIVET OR FOOTMAN

This pattern is more difficult than the one illustrated on page 44, but it has the advantage of being able to be hung on the bar of a grate, as well as standing on the hearth, and it can be moved about more conveniently, as it has a handle.

Method of Procedure

1. Make a full size drawing of the top plate, and take a tracing off this.

Make a full size drawing of top frame, one of the legs, and the handle.

2. Stick the tracing down on to a piece of No. 14 I.S.W.G. metal (brass gilding metal or copper).

3. Drill a hole in each part that has to be pierced out, and where possible drill holes to fit in to the pattern.

4. Saw-pierce out the design, using No. 3 or 4 fretsaw blades.

5. Trim up any irregularities with small files, and file up the surface with bastard and smooth files.

6. Bend up the top frame from $\frac{1}{2}'' \times \frac{3}{16}''$ iron, and turn down the ends. Work to the drawing.

7. Upset and then draw down the tang from $\frac{1}{2}'' \times \frac{1}{4}''$ and weld it on to the frame. If this is too difficult, rivet the tang to frame, using two rivets. After upsetting the end of tang, it must be spread sufficiently in width to take two $\frac{5}{32}''$ rivets, and it must be riveted to under side of frame.

8. Bend up the three legs as drawn and file a tenon $\frac{3}{16}''$ diameter on the back one.

9. Mark positions for legs on iron top frame and position for stretcher on legs.

10. Mark, centre dot, drill and countersink all necessary rivet holes in ironwork.

11. Mark, centre dot, drill and countersink fixing-holes in top plate.

12. Lay top plate on iron frame, mark off, centre dot and drill holes for rivets.

13. Take sufficient $\frac{5}{16}$″ round iron, double it over and weld together at the bend.

14. Bend to correct shape, cut off surplus material, then spread the two ends and file $\frac{1}{4}$″ or $\frac{7}{32}$″ tenon on welded end.

15. Mark, centre dot and drill holes in stretcher for riveting to legs.

16. Rivet legs to top frame, then rivet stretcher to legs. See everything is all upright and square.

17. Rivet top plate to iron frame, using annealed rivets. Flush off rivets on top side of plate so that they do not show.

18. Polish top plate and give ironwork two coats of dead black paint.

19. Turn the handle from a piece of hardwood, working to the drawing. Fit with a brass ferrule and drill hole in handle for tang of iron frame.

20. Heat tang of top frame and drive on the wood handle. Remove and polish the wood handle.

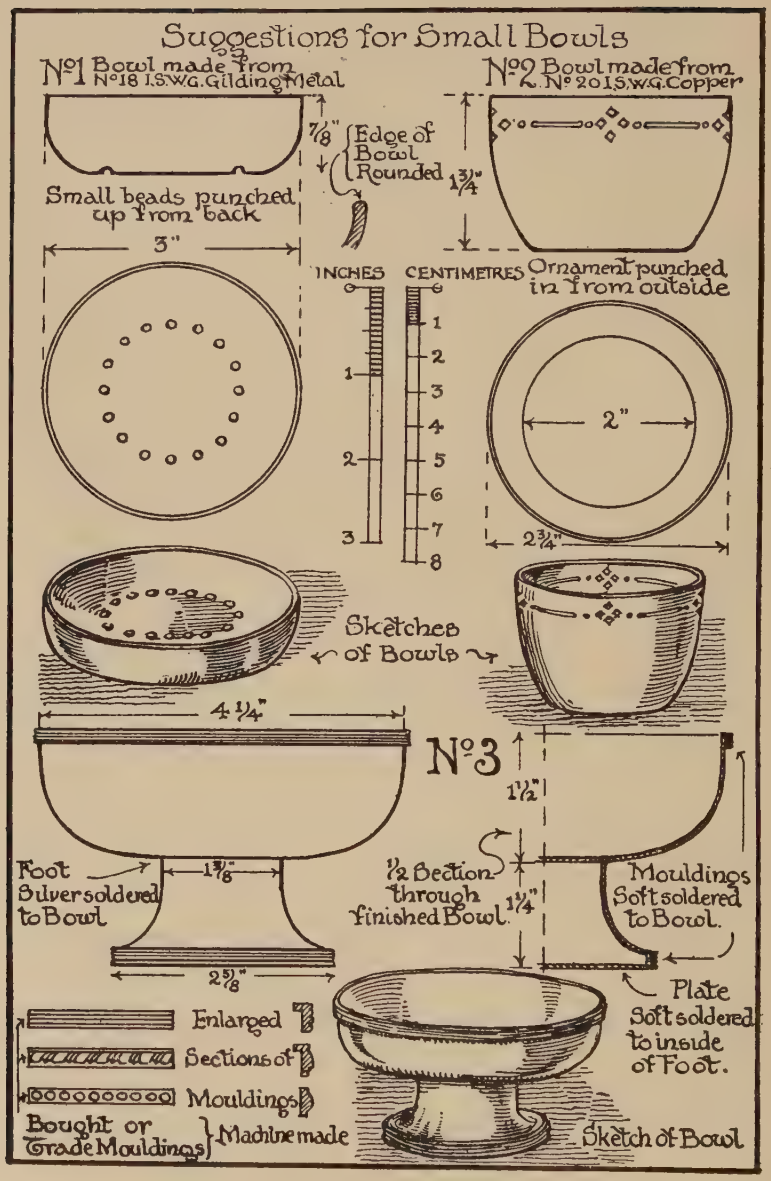
21. Drive handle on to tang tightly, then centre dot and drill a $\frac{1}{8}$″ hole right through centre of ferrule and iron tang. Countersink and fit a brass rivet, and rivet over ends neatly.

22. Give a final polish all over, and touch up ironwork where necessary.

NOTE. The top could be made from wood $\frac{1}{8}''$ thick, and then cast from the wood pattern ; but all the edges would have to be tapered slightly and smoothed, so that the pattern would leave the sand easily.

It could be cast in brass, gunmetal or copper.

PLATE XI


Suggestions for Small Bowls
No 1 Bowl made from No 18 I.S.W.G. Gilding Metal
No 2 Bowl made from No 20 I.S.W.G. Copper
7/8"
Edge of Bowl Rounded
1 3/4"
Small beads punched up from back
3"
INCHES
CENTIMETRES
Ornament punched in from outside
2"
2 1/4"
Sketches of Bowls
4 1/4"
No 3
1 1/2"
Foot Silver soldered to Bowl
1 5/8"
2 5/8"
1/2 Section through finished Bowl.
1 1/4"
Mouldings Soft soldered to Bowl.
Plate Soft soldered to inside of Foot.
Enlarged Sections of Mouldings
Bought or Trade Mouldings
Machine made
Sketch of Bowl

SMALL BOWLS

No. 1

Method of Procedure

1. Develop blank for bowl as indicated on page 58. Cut blank out and file up true, and round the edge.

2. Hammer up to shape as shown on page 42, working to an outline templet.

3. Planish up smoothly on a ball-head stake.

4. Grease inside of bowl and fill with pitch. When set, mark position of small bosses, and hammer them up with a ball tool, taking care not to go through the metal.

5. Warm the bowl and remove the pitch, and clean up the bowl. Place bowl down on a smooth piece of iron and set down the bosses with a cup tool.

6. Clean up with emery cloth and oil, and finish off with polishing paste and whiting.

No. 2

Method of Procedure

This is a more difficult bowl than Fig. 1, and the ornament is hammered in from the outside.

1. Develop blank for bowl, cut it out, and true it up with a file.

2. Hammer bowl up as deeply as possible in a hollow made in a piece of wood, then obtain a small ball-head stake and mallet bowl down on to this ; keep turning the bowl round whilst malleting and gradually contract the metal, making the bowl smaller. Keep checking the shape with an outline templet. (For example of outline templet see page 42.)

3. Turn a piece of boxwood to the shape and size of the bowl, then with a hammer gradually shape bowl to wood mould. Flatten the bottom of bowl on a flat circular piece of iron of the same size as the inside of bowl at bottom.

4. Grease inside of bowl and fill with pitch. When set hard draw design on outside of bowl and trace it in with a lining tool and a small flat square punch and a small pearling punch. Warm the bowl, and remove the pitch, cleaning the bowl inside and out. Slightly round with a smooth file top edge of bowl.

5. Emery cloth and polish the bowl.

No. 3

Method of Procedure

1. Set out the development of bowl as illustrated on page 58 ; also the development of the foot as on page 88.

2. Cut out the blanks from No. 20 I.S.W.G. metal and file up the edges true and to the line of the circle.

3. Hammer up the bowl as shown on page 60, keeping it as smooth as possible.

4. Planish bowl on ball-head stake as shown on page 69, and file top edge parallel.

5. Thin edge for joint of foot, bend up to a conical shape, keep edges closely together and braze with spelter from the inside, using borax as a flux.

6. File off any lumps of spelter.

7. Turn a piece of boxwood to the shape of the foot, keeping it smaller in diameter. Then hammer the foot to the shape so formed, revolving the foot continuously until the shape is correct.

8. File top and bottom of foot parallel, and mark a line round base of foot $\frac{3}{16}$" from bottom edge. Hammer this flange

EXAMPLES OF BOWLS

down on boxwood former, and sharpen up the corner on a steel tool or stake. The scribed line should now be exactly on the corner. File base edge parallel with the corner.

9. Bend up a ring of moulding and silver solder the ends together. This must fit the top edge of bowl tightly.

10. Repeat the above process for the foot.

11. Thoroughly clean inside of moulding and edges of bowl where moulding is to be fixed.

12. Fit foot to bowl, tie it in position with iron binding wire, and silver solder it to bowl. Put borax and water and pieces of silver solder inside the foot, and heat until the solder runs neatly into the joint.

13. Now place bowl in pickle until all traces of borax are removed.

14. Place moulding in position, and soft solder neatly to bowl; repeat the process for the foot.

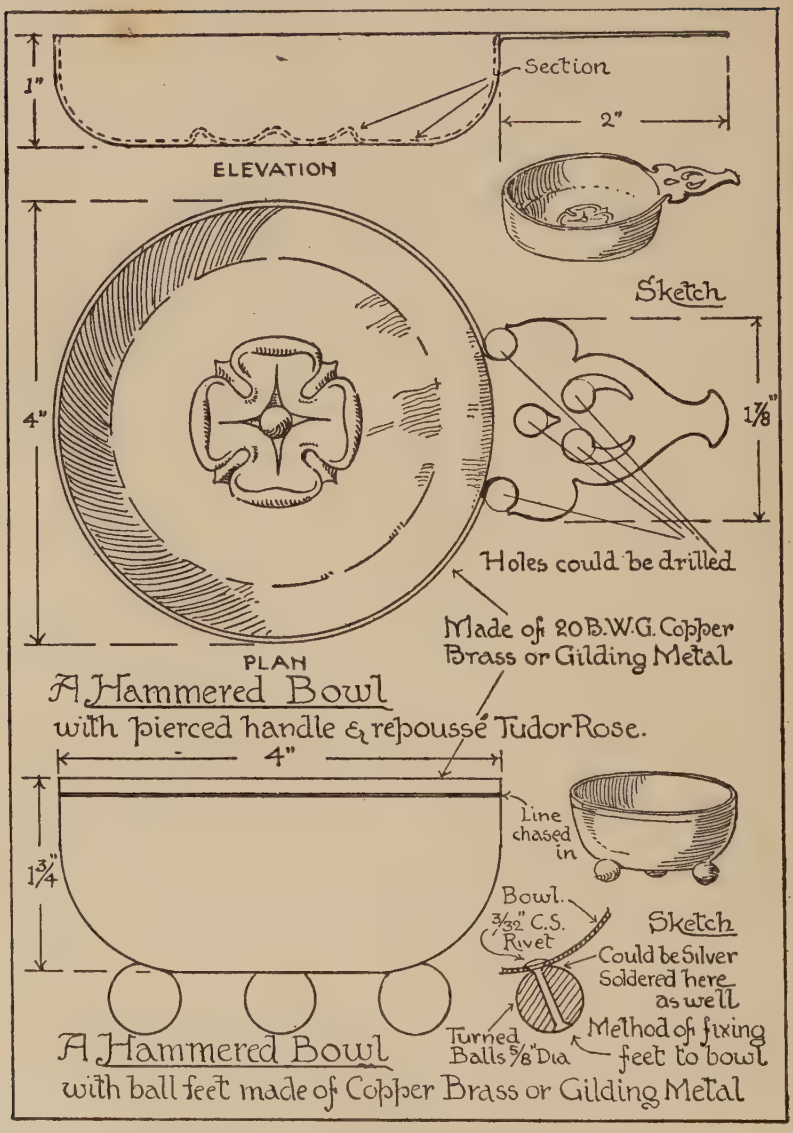
15. Scrape off all the excess solder.

16. Cut out blank for plate in foot and fit it neatly, and drill two small air holes $\frac{1}{16}''$ or $\frac{3}{32}''$.

17. Pack out the plate with a narrow and thin piece of wood, and see that the plate is flush with the edge of foot. Soft solder plate in position and clean off all excess solder with a scraper. Do not file it off.

18. Clean up bowl inside and out with emery cloth and oil. Polish with metal polish and finish off with whiting.

PLATE XIII


1"
Section
2"
ELEVATION
Sketch
4"
1⅛"
Holes could be drilled
Made of 20 B.W.G. Copper Brass or Gilding Metal
PLAN
A Hammered Bowl
with pierced handle & repoussé Tudor Rose.
4"
1¾"
Line chased in
Bowl.
3/32" C.S. Rivet
Sketch
Could be Silver Soldered here as well
Turned Balls ⅝" Dia
Method of fixing feet to bowl
A Hammered Bowl
with ball feet made of Copper Brass or Gilding Metal

A HAMMERED BOWL WITH PIERCED HANDLE

Method of Procedure

1. Develop blank for bowl as shown on page 58, leaving sufficient metal on one side for the handle. Cut it out of No. 20 I.S.W.G. metal. File all the edges up truly.

2. Hammer bowl up to shape as shown on page 60, keeping metal for handle parallel with base of bowl all the while the bowl is being raised. Work to a metal templet as shown on page 42.

3. File top edge of bowl parallel with base, and planish bowl on ball-head stake (see page 69).

4. Make a half templet of handle.

Draw a line down centre of bowl and handle. Scribe out the handle with a steel scriber, working each side of centre line with the templet as a guide.

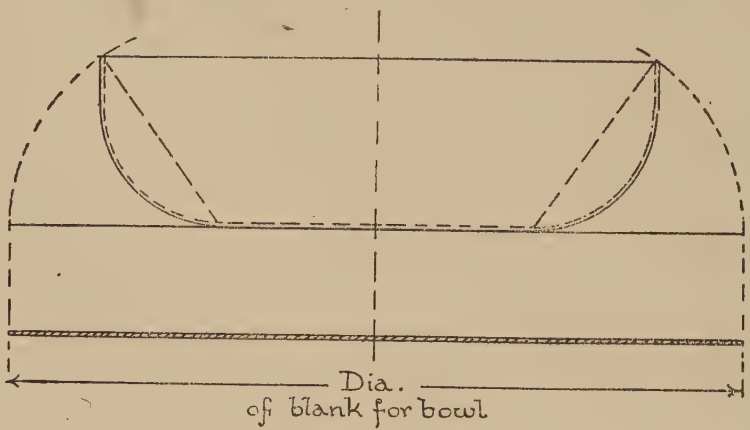
5. Cut out the handle, drill the holes where marked. Centre dot them first. File up the handle neatly to the scribed line. Round all edges with a smooth file.

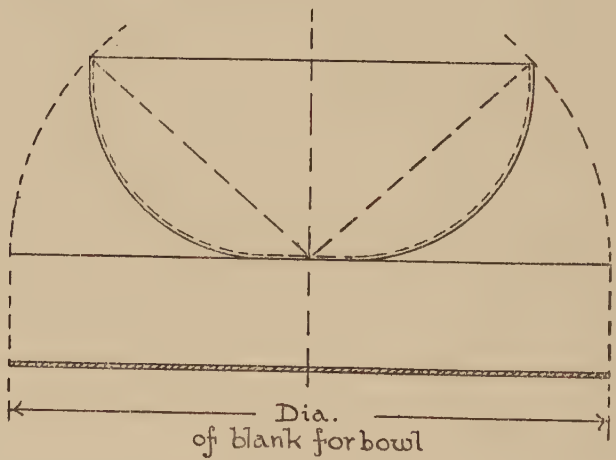
6. Emery cloth bowl all over inside and out.

7. Polish all over with metal polish.

NOTE. If the Tudor rose is required, fill the bowl with pitch, and when it is hard stick bowl on a pitch block. Draw design on bottom of bowl, and model the rose from this side ; then reverse the bowl and finish off the face of the rose.

PLATE XIV





Method
of obtaining sizes of blanks for bowls

A HAMMERED BOWL WITH BALL FEET

Method of Procedure

1. Develop blank for bowl as shown on page 58.

2. Cut it out of No. 20 or No. 18 I.S.W.G. metal, and file up the edges true to the circle.

3. Hammer the bowl to shape, using a templet as shown on page 42, and raising it as illustrated on page 60, and finish it off by planishing on ball-head stake.

4. File top edge of bowl parallel with base.

5. Chase line round edge of bowl with a lining tool holding bowl on to a piece of lead.

6. Turn the ball feet from a piece of $\frac{3}{4}$" brass rod, using a ripper and a forming tool as illustrated on page 34.

7. Centre dot top and bottom of each ball and drill the hole, working from both sides of the ball. Countersink one side of hole.

8. Mark position of holes in the bowl and centre dot them. Drill holes in bowl, and countersink holes on the inside of bowl.

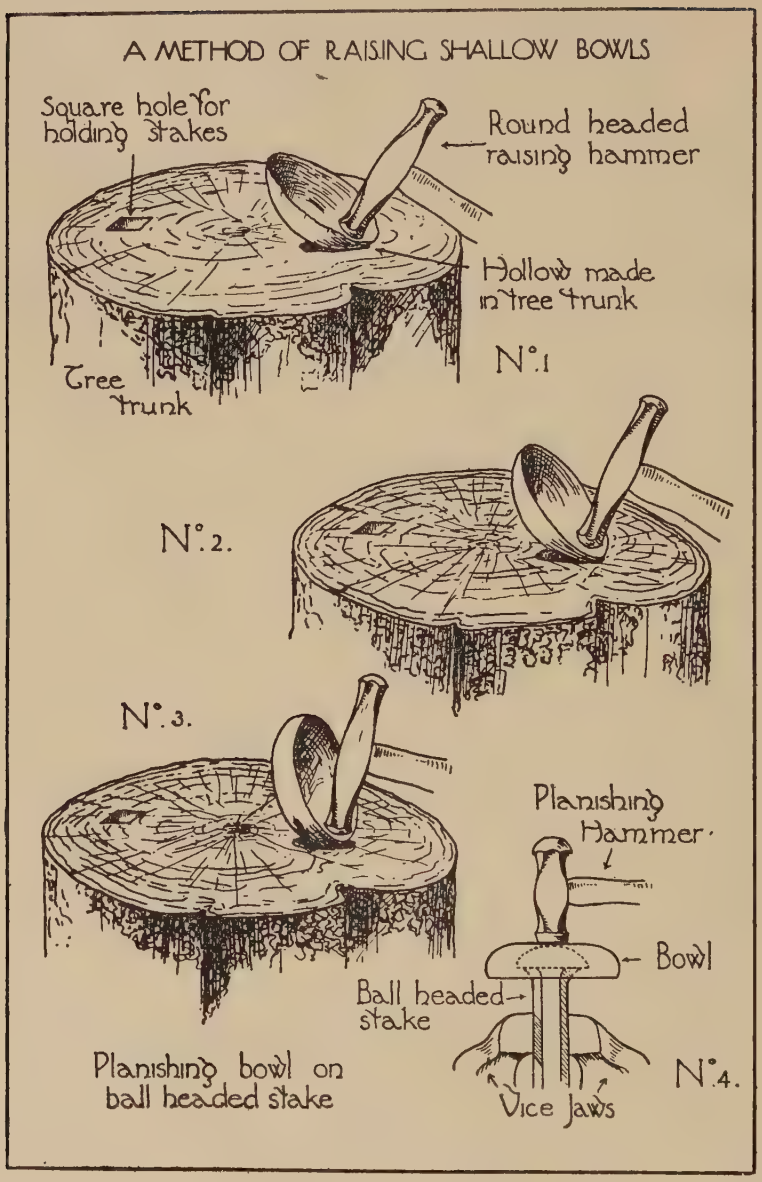
9. Fit and anneal the rivets, and rivet ball feet to bowl, taking care not to mark the bowl.

10. Emery cloth the bowl all over, and polish with polishing paste.

NOTE. This bowl could be either tinned inside or silver-plated.

A method of making the edges of bowls level is to rub them on a large flat emery wheel. This being heavy it can be laid on the bench and does not move while the bowl is being levelled.

PLATE XV


A METHOD OF RAISING SHALLOW BOWLS
Square hole for holding stakes
Round headed raising hammer
Hollow made in tree trunk
Tree trunk
N°.1
N°.2.
N°.3.
Planishing Hammer.
Bowl
Ball headed stake
Planishing bowl on ball headed stake
N°.4.
Vice Jaws

SHALLOW TRAYS OR PLATES

No. 1—Page 64.

Method of Procedure

1. Set out the blank with compasses, and also the circle for the centre, and allow $\frac{1}{4}$" or $\frac{5}{16}$" over all for wired edge. It is not necessary to allow for raised portion in centre.

File up the edge truly, working accurately to the scribed line.

2. Make a templet exactly to depth of plate, and cut out a piece of wood as shown on page 69, Fig. 1A, working to the templet.

3. Place nails in position in wood block for regulating width of flange.

4. Place wood block in vice and hammer up dish as shown on page 69. After taking a few courses round the dish you flatten it with a wood mallet and boxwood punches ; repeat this process, and if the metal gets very hard anneal it.

5. Planish plate on ball headstake as shown on page 69, Fig. 3.

6. Go over plate with flat wood punches and a planishing hammer until it is perfectly flat.

7. Slightly grease face of plate, and stick plate down on to a bed of pitch. When set, clean back of plate with emery cloth and scribe in the design and also the lines for position of wire edge.

8. Hammer up design with punches, and make the groove for the wire.

9. Remove plate from pitch and clean it up all over. Finish making groove for wire as shown on page 64, Fig. A.

10. Bend up circle of No. 14 I.S.W.G. wire, and file the ends to make a neat butt joint. See that the circle of wire fits the groove correctly.

11. Place wire in groove and tuck the metal over the wire in three or four places. Then work the metal over the wire

in between places already done, and continue this process until all the wire is properly covered with metal ; then with a grooving tool (see page 42), smooth wired edge, working mostly on the front of plate.

12. Clean plate all over with emery cloth and oil, and finish off with polishing paste, etc.

No. 2—Page 64.

Method of Procedure

1. Cut out a piece of No. 22 I.S.W.G. metal one inch larger than finished plate.

2. Flatten it with a boxwood punch and clean one side of it with fine emery cloth. Then draw the design on the metal and scribe the design in with a steel scriber.

3. Slightly grease the other side of the metal, and bed it down on the pitch.

4. Slightly warm the surface of the metal and work the design down into the pitch, using suitable steel punches. When the plate is about half finished remove from pitch and thoroughly clean and anneal. Flatten centre of plate on a smooth piece of iron.

5. Replace plate on the pitch, and continue the above process until the modelling on this side is finished. Remove plate from pitch and thoroughly clean.

6. Refix plate on the pitch (raised side uppermost), and punch the small pearls at the ends of the flutes and smooth the flutes up generally. Now trace in the groove for reception of the wire.

7. Remove plate from the pitch and thoroughly clean both sides. Make the octagon wire frame, butting the ends of wire together in the centre of a flat side, and make sure the wire fits the groove accurately.

8. Mark a line outside the groove, allowing sufficient metal to cover the wire. Cut off surplus metal, nick a small

piece of metal from each corner, and hammer the metal over the wire. Place flange of plate face side uppermost on a smooth iron plate and set down the wired edge with a grooving tool as illustrated on page 42.

9. Go over the plate and dress down any lumps or irregularities, working from both sides alternately. See that the rim is parallel with the bottom of plate and that the plate stands firm.

10. Clean plate all over with emery cloth and oil, and polish with polishing paste, etc.

No. 3—Page 64.

Method of Procedure

1. Obtain a piece of No. 20 I.S.W.G. metal, and cut it out $1\frac{1}{2}''$ larger each side than the finished tray.

2. Raise this to the correct depth on a block of wood, as illustrated on page 69.

3. Grease the inside of tray, and fill it with pitch. When set hard stick the tray on a bed of pitch, then model up the shapes with suitable punches and make the bead.

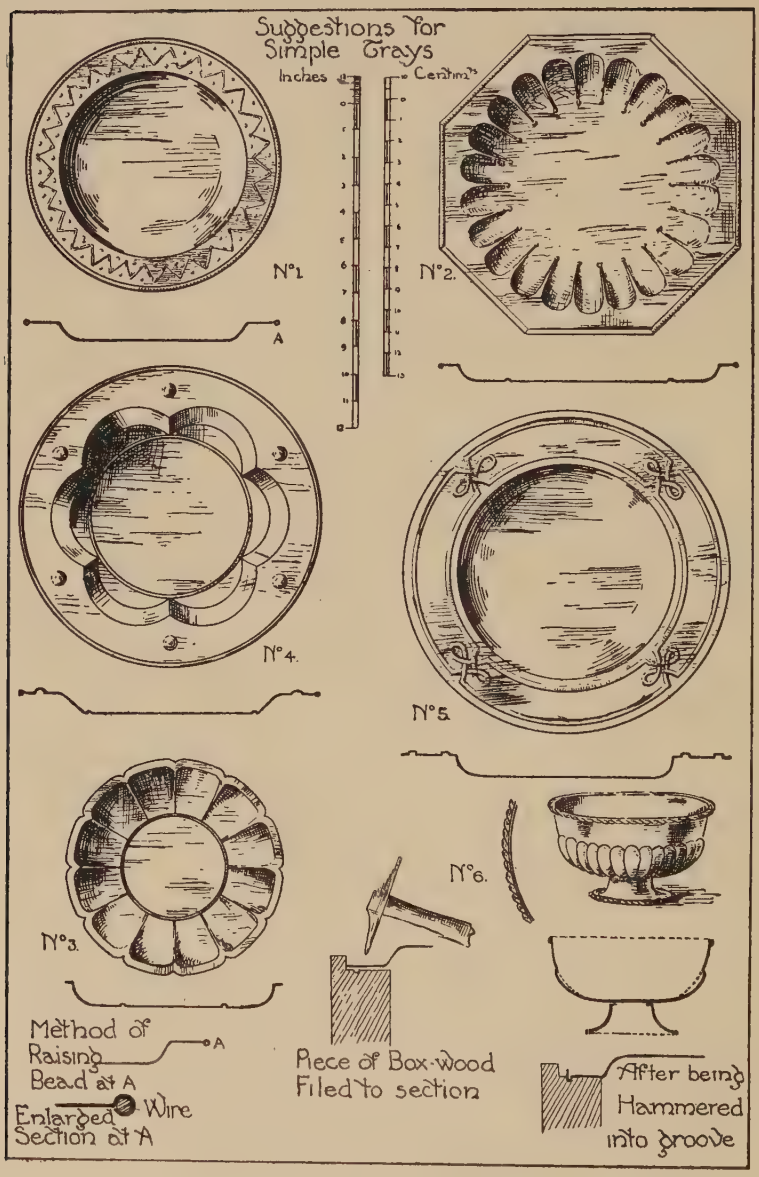
4. Remove tray from the pitch, thoroughly clean it inside and outside, and flatten it with boxwood punches on a smooth and flat iron plate.

5. Grease outside of tray and bed it in the pitch, and while it is warm, model the shapes with smooth steel punches. Trace a line along the extreme outside of the tray. Now cut along this traced line with a narrow and thin cold chisel, and then remove the tray from the pitch. Thoroughly clean off the pitch as described on page 19.

6. File up the edge with a smooth file and correct any irregularities.

7. Clean it up inside and outside, and polish and lacquer if required.

PLATE XVI


Suggestions for Simple Trays
Inches
Centims
N°1
A
N°2.
N°4.
N°5.
N°6.
N°3.
Method of Raising Bead at A
A
Enlarged Section at A
Wire
Piece of Box-wood Filed to section
After being Hammered into groove

SHALLOW PLATES

No. 4—Page 64.

Method of Procedure

1. Cut out a piece of metal 1 inch larger all round than the plate, clean one side with fine emery cloth, scribe in the design, slightly grease the opposite side and stick the greased side of the metal down on to the pitch block after pouring some warm pitch over the metal.

2. When the pitch is nearly cold commence to work up the design with punches and round-headed hammers. If the pitch gets hard slightly warm the face of the metal with a gas flame and then repeat the raising process.

3. Line in the bead in the centre of the plate.

4. Remove plate from pitch and thoroughly clean, grease the hollow side and bed down on the pitch.

5. Before the pitch is cold work up the design and sharpen the outline. Raise the bead between the lines marked, and raise the bosses. Then line in the groove for the wire. (Another method of preparing a groove for the wire is shown at foot of page 42.)

6. Remove plate from pitch, reverse and refix on pitch and press down all irregularities, and set down the inside portion of the outer bead which is to hold the wire.

7. Remove plate from pitch, thoroughly clean both sides and flatten both centre and flange on a smooth and flat iron plate. Cut off surplus metal.

8. Make the wire circle and butt the joint neatly. Lay wire in the groove and fix metal over the wire at four equal points. Continue working metal over the wire, using a small hammer until the edge is finished.

9. Lay border of plate on a smooth and flat iron surface, and dress down the beaded edge with a grooving tool as illus-

trated on page 42, and then work the centre down on to a flat iron plate so that the tray does not wobble.

10. Clean up all over with emery cloth (coarse to fine) and oil. Finish off with liquid polish, and wipe over with whiting.

SIMPLE TRAYS

No. 5—Page 64.

Method of Procedure

1. Cut out a piece of No. 22 or No. 20 I.S.W.G. metal correct to finished size, and true up the edge with a smooth file.

2. Raise the centre as illustrated on page 69.

3. Grease the back of the plate. Fix it on the pitch block (see page 19).

4. Clean the border of the plate with emery cloth, and transfer the design from the drawing to the plate, using carbon paper. Line in the design with a steel scriber.

5. Go over all the lines with a tracer, keeping the lines a uniform width and depth.

6. Remove plate from the pitch (see page 19), thoroughly clean and grease the inside and refix on the pitch.

7. Raise the border and model it to the correct sections.

8. Take the plate off the pitch, reverse and continue the modelling on the face until finished.

9. Remove plate from the pitch, thoroughly clean and flatten plate from the back and the front on a smooth and flat piece of iron.

10. Clean the plate all over with emery cloth and oil, and finish off with polishing paste and whiting.

No. 6—Page 64

Method of Procedure

1. Develop blank for bowl as illustrated on page 58 ; then raise the bowl as shown on page 60, and planish it.

2. Develop foot of bowl as shown on page 88, thin the edges for the lap, form into a cone and braze together from the inside. Place in pickle until all the borax has been dissolved.

3. Grease inside of bowl, then fill with pitch, when set hard place some liquid pitch on pitch block and stick bowl on this.

4. Clean outside of bowl and set out the flutes, using a templet for the rounded ends of flutes and a flexible rule for scribing in the straight lines.

5. Line the design in with straight and slightly curved tracers.

6. Remove the bowl from the pitch, clean and reverse, being sure the inside of the bowl is clean.

7. Raise the flutes from the inside of the bowl with a rounded steel punch, and keep them a good shape and very smooth.

8. Remove bowl from pitch, and clean and planish top portion on a rounded stake.

9. Turn a piece of boxwood in the lathe to the shape of the foot, using a templet.

10. Place cone on former and hammer it to shape. Keep it revolving all the time.

11. File top and bottom of foot parallel, and with a pair of compasses mark a line $\frac{3}{16}$″ away from the bottom edge. Working from this line hammer the edge down on an iron stake to form the step to take the moulding.

12. Using a scribing block and a surface plate mark the circle on the bowl for the position of foot. Wire foot in position with six or eight ties of binding wire.

13. Fill bowl with dry sand and small cinders, and place on forge with foot uppermost. Then place some borax and water in the foot, also some small pieces of silver solder. Heat until silver solder runs into the joint, remove the iron wire and place bowl in pickle until all the borax has dissolved.

14. Make the moulding for top and foot into rings, and silver solder the ends together. These rings must fit tightly. Clean the outside edge of the top part of bowl, and also the step of foot ready for soft soldering.

15. Clean the inside of rings of moulding ready for soft soldering.

16. Soft solder the ring to the top edge of bowl and the ring to the base of foot. Then clean off all excess of solder with a scraper.

17. Clean up bowl with emery cloth and oil and polish in the usual manner. This bowl might be silver-plated or the inside of bowl might be plated and the outside stained a dark red and then lacquered.

A turned wood base fitted to the foot of this bowl would make a better finish.

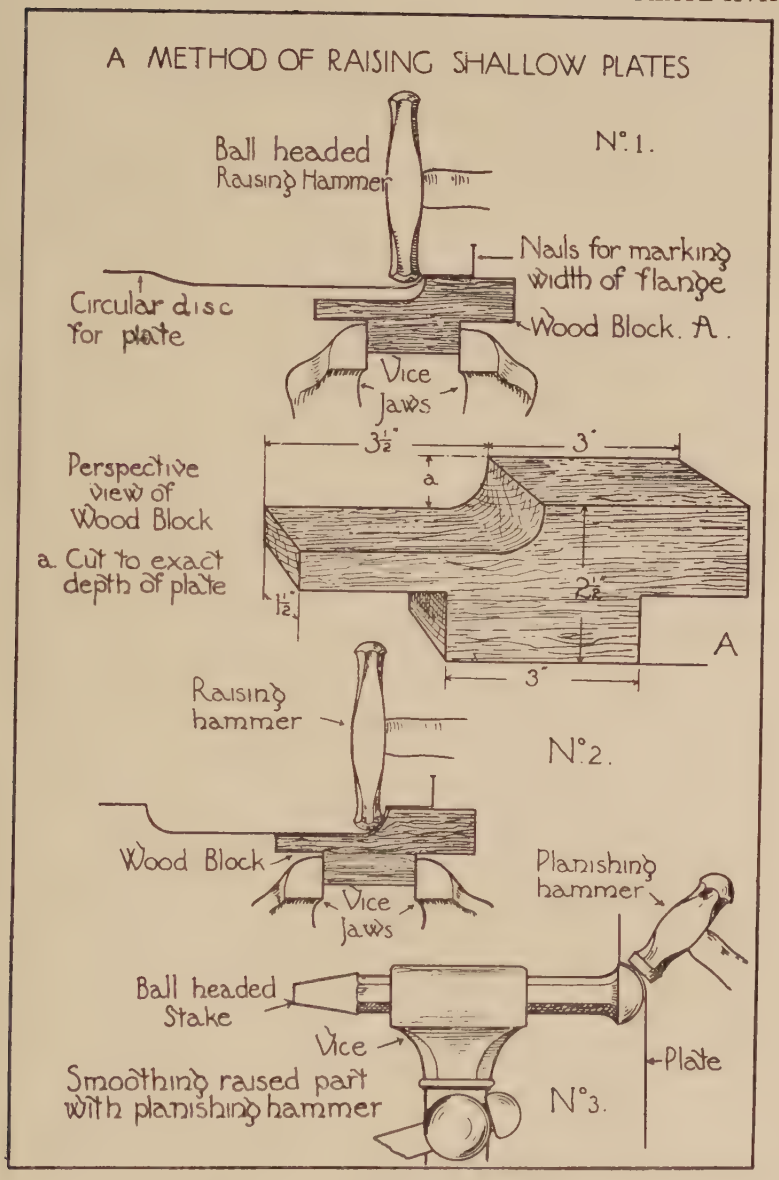
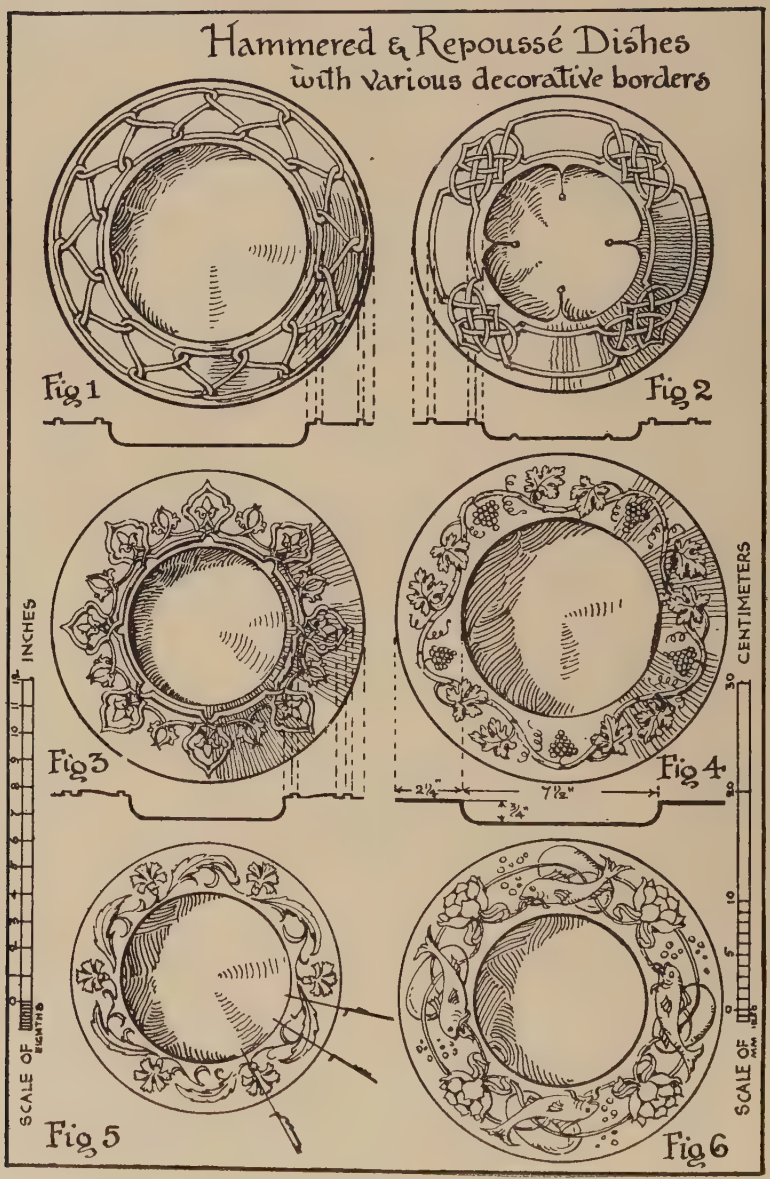

A METHOD OF RAISING SHALLOW PLATES
Ball headed Raising Hammer
N°1.
Nails for marking width of flange
Circular disc for plate
Wood Block. A.
Vice Jaws
3½"
3"
a
Perspective view of Wood Block
a. Cut to exact depth of plate
1½"
2½"
A
3"
Raising hammer
N°2.
Wood Block
Vice Jaws
Planishing hammer
Ball headed Stake
Vice
Plate
Smoothing raised part with planishing hammer
N°3.

PLATE XVIII


Hammered & Repoussé Dishes
with various decorative borders
Fig 1
Fig 2
Fig 3
Fig 4
Fig 5
Fig 6
INCHES
CENTIMETERS
SCALE OF EIGHTHS
SCALE OF MM.

REPOUSSÉ COPPER TRAY. (Fig. 6, Page 70)

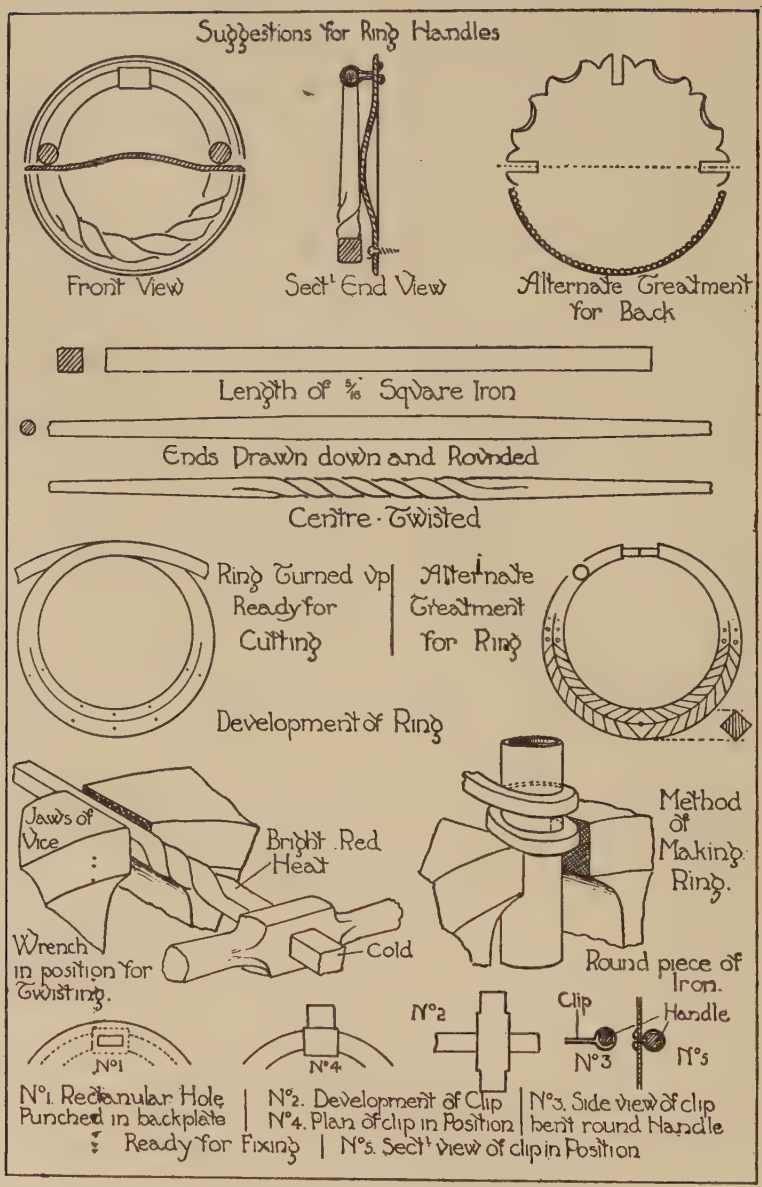
HAMMERED AND REPOUSSÉ DISHES

These suggestions are variations of the preceding trays, and show the developments of the simplest form to quite an advanced stage.

The photograph of Fig. 6 on page 71 is taken from the finished plate, and conveys a better idea or conception of the modelling than can be given in a line drawing. All these dishes are made in the same manner as the model No. 1 described on page 61. There is really no end to the variety of design and treatment that can be devised for these objects.

The preparation and elaboration of the design provides good material for lessons in clay modelling, and if these are followed up by the making of a plaster cast much help will have been gained in overcoming difficulties in the modelling and raising of the plate or dish.

PLATE XX


Suggestions for Ring Handles
Front View
Sect^l End View
Alternate Treatment for Back
Length of 5/16 Square Iron
Ends Drawn down and Rounded
Centre-Twisted
Ring Turned up Ready for Cutting
Alternate Treatment for Ring
Development of Ring
Jaws of Vice
Bright Red Heat
Cold
Wrench in position for Twisting.
Method of Making Ring.
Round piece of Iron.
N°1
N°4
N°2
Clip
Handle
N°3
N°5
N°1. Rectangular Hole Punched in backplate Ready for Fixing
N°2. Development of Clip
N°4. Plan of clip in Position
N°3. Side view of clip bent round Handle
N°5. Sect^l view of clip in Position

RING HANDLES

Method of Procedure

1. Cut out backplate from No. 16 I.S.W.G. mild steel with hammer and chisel.

2. File up to correct size and shape, and face one side. Then raise centre portion with a ball pane hammer on a lead block, and planish the front on a ball headstake.

3. Obtain a piece of $\frac{1}{4}''$ square mild steel, and draw down the ends ; then heat the centre and twist as shown in drawing.

4. Heat handle all over and bend circular on a piece of round iron as drawn, letting ends overlap.

5. Cut through centre of overlapping pieces with a hack-saw and flatten the handle so that the ends are in line.

6. File the tenons, being careful that shoulders are parallel. Use a small safe edge file for shoulders.

7. Make the clip as drawn, heat and bend over tenon.

8. Punch rectangular hole in backplate on a lead block from the front side ; then drill the fixing holes. (Centre dot them first.)

9. File off the burr at back of rectangular hole, and slightly chamfer top and bottom of hole to receive thickness of clip.

10. File up handle all over with a smooth file and emery cloth both backplate and handle to a bright finish.

11. Heat end of clip to a red heat, then insert in hole. Open ends with a chisel, and beat flat on to backplate.

12. Finish job off all over with fine emery cloth and oil.

PLATE XXI

18th Century Brass Handle No 1
Section of handle through centre
4⅛"
Front view of Bolt showing Section
Handle
Screwed Square
Side elevation of Bolt
Brass Escutcheon to match Handles No 3
2½"
18th Century Brass Handle No 2
4¼"
Front Elevation No 4
6"
1½"
2"
.5"
Side Elevation At Simple Iron Handle
7¼"
Length of 7/16" Round Iron
8"
⅜"
¾"
7/16 hole
Ends spread out & holes drilled
Side Elevation
1⅛"
1½"
3/16" Rivets
Made from No 12 S.W.G Mild Steel
Plan of Backplate
3/16 hole
Perspective Sketch

AN IRON DOOR HANDLE

Method of Procedure

1. Obtain a piece of sheet iron a little larger than the handle, and chalk all over one side of it. On this, draw out (full size) the side view of handle.

2. Cut off a piece of $\frac{7}{16}''$ round mild steel to length, hold in the hollow bit tongs, and heat one end and spread as shown on drawing. Reverse iron and repeat.

3. Drill holes in the ends (centre dot them first).

4. Heat the handle and bend up to shape, working to the drawing on the sheet iron.

5. Obtain some $1\frac{1}{2}'' \times \frac{1}{8}''$ mild steel hooping, and cut off backplate to correct length. Then file up and chamfer.

6. Chalk over the face of backplate and set out the holes and centre dot them. Countersink the fixing holes on the front and the rivet holes on the back.

7. Cut off rivets to correct length, fit them and anneal them.

8. Rivet handle to backplate and rest heads of rivet in a cup tool to prevent bruising.

9. Give two coats of black paint.

EIGHTEENTH CENTURY BRASS HANDLE

NOS. 1 AND 2—PAGE 76

Method of Procedure

1. Cut out the backplate from a thin piece of mahogany and trim it up to shape and bevel the edge. Make small countersunk dots where holes for bolts will be.

2. Cut out the handle from a piece of $\frac{5}{16}$" thick mahogany. Allow for shrinkage and filing. File the wood handle to the correct shape, and finish off with fine glass paper. Give the pattern so formed two coats of shellac.

3. From a piece of brass rod turn two bolts (in one piece). Allow for shrinking and subsequent turning. (This will be the pattern.)

4. Have brass castings made from these patterns, and on receipt of castings anneal and pickle them.

5. File up the castings of backplates and handles, using bastard and smooth files.

6. Turn the heads of bolts in the lathe, separating them when finished. Screw the bolt with a B.A. solid die. File up the square behind the head, centre dot and drill the bolt head to receive the end of the handle, which must be accurately filed to fit.

7. Polish these parts on a fast-running calico mop, using sand, and finish off with Tripoli and Sheffield lime.

8. Wipe off all the grease and dirt left from polishing, and lacquer with a colourless lacquer.

N.B. The nuts for these handles could be made from hexagon brass rod, or they could be bought ready made at a small cost.

BRASS ESCUTCHEON

No. 3—Page 76

Method of Procedure

1. Cut out escutcheon from a thin piece of mahogany.

2. File up to shape, bevel the edge, and cut the keyhole, leaving the sides of the keyhole slightly bevelled so that it leaves the sand. Mark the position of fixing holes with the point of a drill.

3. Get a casting made from this in brass.

4. Take all the burrs off the casting, lay the escutcheon on a piece of wood and place short nails or pins round the edges and face up the escutcheon with bastard and smooth files.

5. Drill fixing holes. Then remove the escutcheon from wood block.

6. File up the outside edges and the keyhole. Then chamfer the escutcheon with bastard and smooth files.

7. Polish and lacquer with a colourless lacquer.

PLATE XXII

Suggestions for Iron Drop Handles & a Latch
Nº 1
Side Elevation
Side View of Handle
Nº 2
Side Elevation
Nº 3
Side Elevation
Nº 4
Section
4 Holes for screws
4 Holes for rivets
Developement of Clip ends thinned down
Rectangular hole punched
Nº 6
Iron Latch showing front elevation
Back plate Nº 14 S.W.G. Mild Steel
Tenons rounded & riveted through plate
Developement of Spring before bending
Thin Washer
Rivet
Bolt
Section shewing fixing of bolt to Back Plate
Side View of Knuckle
Section
Nº 5
Side View of Catch
Ring butted together and tenoned

IRON DROP HANDLES

PLATE—PAGE 80

Nos. 1, 2, 3, 4 and 5 are really variations of the ring drop handles illustrated on page 74, and the method of procedure is practically the same as that set out on page 75, but there are a few points that may assist in making them.

No. 1. This ring must be bent to a circular form and then flattened and placed in a hollow grooving tool. The grooved portion shown is hammered into a groove with a narrow pane hammer.

No. 2. Calls for no comment.

No. 3. The clip for this is made and riveted neatly to the backplate. Sometimes the top rivet hole is left blank and the fixing screw is passed through it.

No. 4. The bending and forging of this is more difficult. The ends have to be drawn down and curled up hot, and the bend at the knuckles is done last. The points for bending must be carefully marked. One end is bent hot, and then the handle is reheated and bent over a piece of iron the same width as the clip. This process is repeated until the bend is completed.

This handle could also be made by bending the knuckle portion first and curling the ends up last. The bend at the knuckle is the most difficult part.

No. 5. The backplate of this handle requires more skill in filing than the others. The pierced portions should be drilled out as much as possible, then cut out with small chisels and finally filed and chamfered.

Where you have a solid knuckle to hold the handle, as in Nos. 1, 2 and 5, a square hole and a square tenon should be made so that the handle does not twist round.

AN IRON LATCH

No. 6—Page 80

Method of Procedure

1. Draw a line lengthwise down the centre, and make a half templet of each piece from thin sheet metal.

2. Obtain a piece of No. 14 I.S.W.G. mild steel and draw a line, placing the centre line of the templet against the line. Go all round the templet with a brass wire scriber ; then repeat on opposite side.

3. Cut out the two pieces for the backplate with a hammer and small chisel. File up the edges and centre dot position of holes for piercing. Also centre dot the fixing holes, bolt hole, and holes for spring and catch. Drill the holes, and with a small chisel cut out the remainder of the piercings.

4. Cut out development of spring on a piece of No. 12 I.S.W.G. mild steel. Bend at the corner while hot ; then fit the spring to the holes. Hammer tail end of spring, and thin it while cold. File it up to shape again, and hammer it until it is springy, then refit and shape it to the backplate.

5. Obtain a piece of $\frac{1}{2}'' \times \frac{3}{16}''$ mild steel and set out the bolt. Centre dot position of holes for bolt and knob. Drill the holes and file up the bolt to shape and size.

6. Obtain a piece of $\frac{5}{8}'' \times \frac{3}{16}''$ mild steel, and file up the catch and fit it to the place provided.

7. Get a piece of $\frac{1}{2}''$ round mild steel and turn up the knob in a lathe, or file it up by hand. Fit knob to bolt.

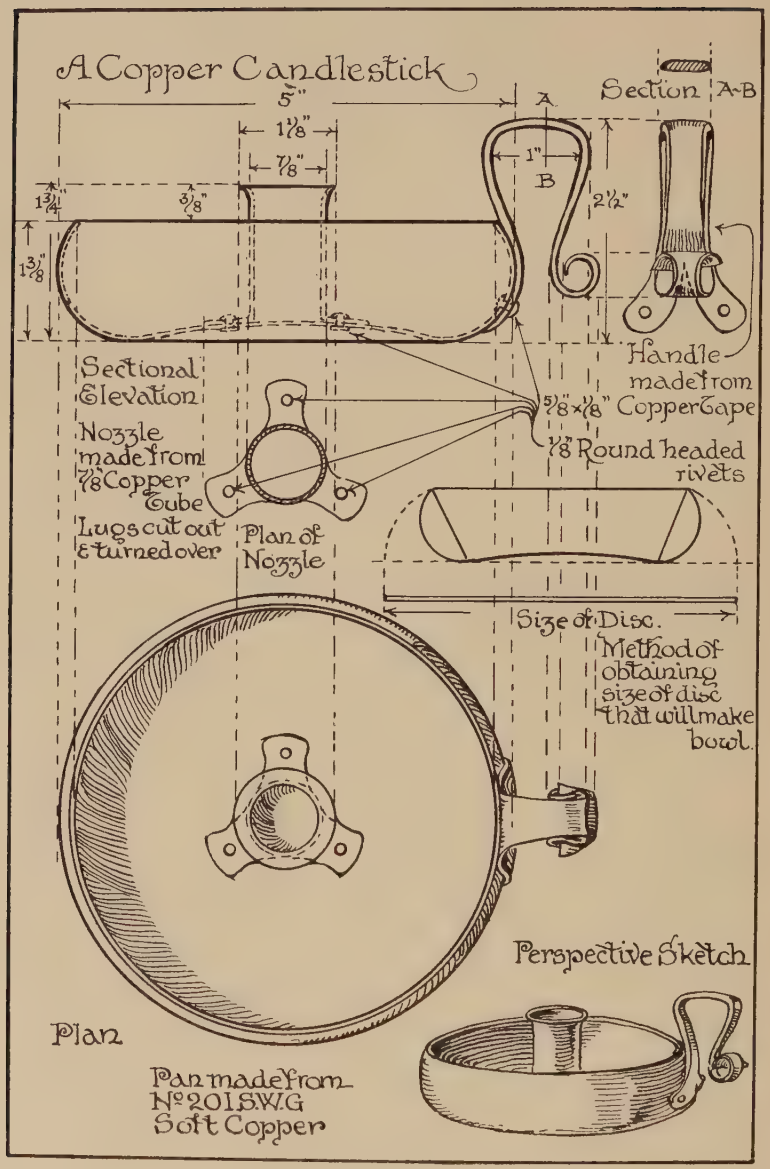
8. Face up the backplate and finish it off with fine emery cloth and smooth up all edges and chamfers.
Finish off spring, bolt and catch.

9. Rivet knob to bolt, rivet bolt to backplate and make it work easily but not loosely. See that the thin washer does not show.

10. Try catch in position, and try the bolt. If it is correct rivet the catch to the catchplate. Fit the spring and see that the bolt works and sets in the catch. Shorten the tenons on the spring and see the holes are countersunk to receive the ends of the tenons. Now rivet the spring into position.

11. Give the latch a final polish and a coating of vaseline.

PLATE XXIII


A Copper Candlestick
5"
1⅛"
⅞"
1¾"
⅜"
1⅜"
A
B
1"
2½"
Section A-B
Handle made from 5/8"×⅛" Copper Tape
⅛" Round headed rivets
Sectional Elevation
Nozzle made from ⅞ Copper Tube
Lugs cut out & turned over
Plan of Nozzle
Size of Disc.
Method of obtaining size of disc that will make bowl.
Perspective Sketch
Plan
Pan made from No 20 I.S.W.G Soft Copper

CANDLESTICK

Method of Procedure

1. Cut out blank for bowl, and hammer it up to shape, using first a round-ended boxwood mallet and then a ball-headed hammer, and hammer the copper into a lead block with a hollow in it, or into a hollow carved out of a very heavy piece of wood (see page 60). Keep working on this until it is the correct size and shape.

2. Now planish the bowl on a polished ball stake with a polished face hammer.

3. Cut off $2\frac{3}{8}''$ of $\frac{7}{8}''$ No. 20 I.S.W.G. copper tubing; then set out the lugs and cut away the metal between them. File the lugs up to shape, centre dot position of holes on lugs and drill the holes.

4. Anneal the nozzle and bend the lugs over to fit bottom of bowl. Bell-mouth the opposite end on an extinguisher stake with round-headed hammer.

5. Now mark position of holes on bottom of bowl, centre dot them and drill them, and countersink under side to receive the riveting over of rivet.

6. Obtain about 2′ 6″ of $\frac{5}{8}'' \times \frac{1}{8}''$ copper tape, heat end to a very dull red heat, and spread the end with a hammer. Then take off with a piece of string the correct length of handle needed, working from the drawing and reforge where necessary. File it up all over to the correct shape. Reheat and bend it up partially to shape. Now cut it off from the length of material, finish shaping the end and then complete the bending up to the correct shape of handle.

7. Trim handle up with smooth file and set it to the shape of the bowl. Mark positions of rivet holes, centre dot and drill them.

8. Soft solder handle to bowl (using very little solder and a suitably hot iron). Drill holes right through bowl, using existing holes in handle as a guide.

9. Rivet handle and nozzle to bowl, using round-headed rivets, the heads to be held in a cup-shaped tool. Then form rounded heads with the hammer and finish off by smoothing with another cup-headed tool, thus leaving a rounded head each side of bowl.

10. Thoroughly clean off all soft solder with a scraper and, using some emery cloth and a little oil, polish the job all over inside and out. When this has been done thoroughly, finally polish with any sort of metal polish and dry with a soft cloth that has been dipped in powdered Sheffield lime (or whiting).

A CANDLESTICK

Method of Procedure

1. Develop blank (for method of doing this see page 58) required for bowl. Cut it out, and true up the edges.

2. Develop pattern for foot and allow $\frac{1}{8}''$ extra for lap. Cut metal out for foot and true up all edges, thin each end for lap.

3. Develop pattern for nozzle direct on to the metal, allow $\frac{1}{8}''$ extra for lap. Cut out the metal, true up the edges and thin the ends for lap.

Make an outline templet of foot and of the bowl.

4. Hammer up the bowl so that it fits against the outline templet and is also of the right diameter.

5. Bend up the foot and the nozzle, and see that the lap joints are perfectly tight and close together. Then silver solder (or braze if copper) the joint.

6. Hammer up the foot on a shaped piece of wood, until the foot fits the outline templet.

7. Hammer out the mouth of the nozzle as shown on the drawing.

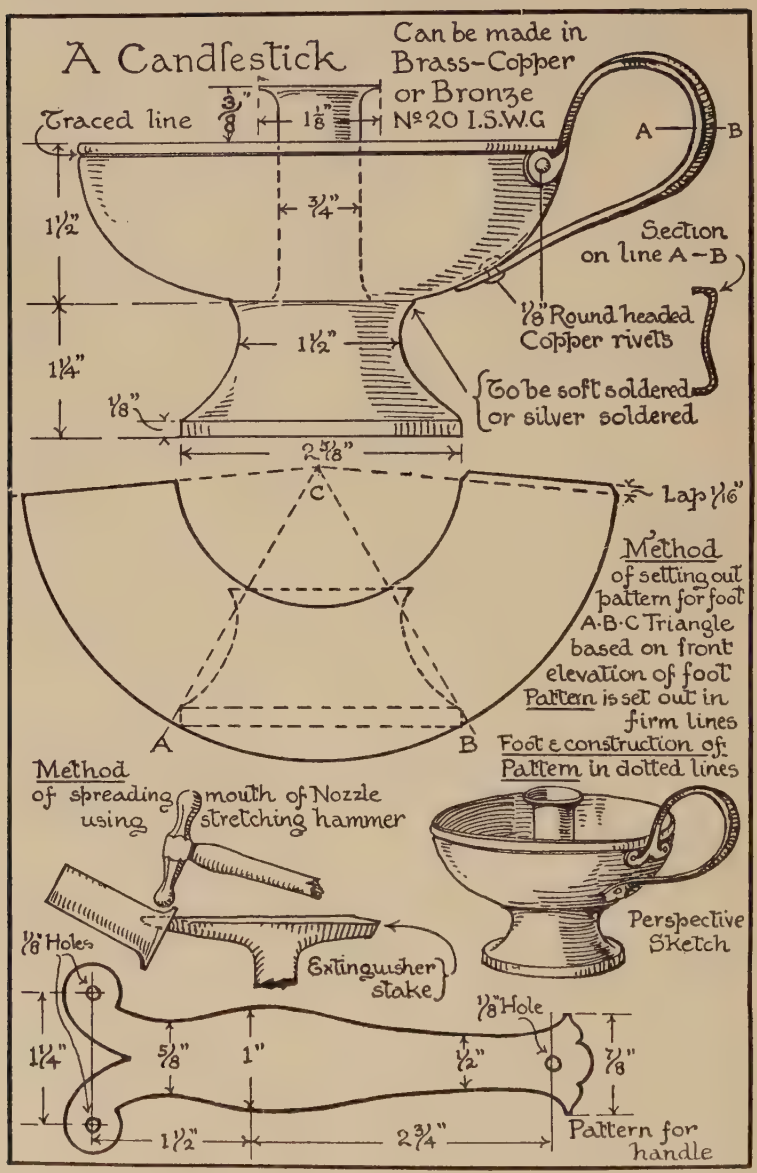
8. Fit the foot to the bowl and tie it in position with iron binding wire.

Be sure it is in the centre. Then silver solder it to the bowl, placing borax and water and silver solder inside the foot and heat it from the outside until the solder runs into the joint. Place job in pickle until it is cleaned of all borax.

9. Rest inside edge of bowl on a piece of lead, and trace the line regularly round the bowl as drawn. Hold tracing tool in vice and rest extreme edge of inside of bowl on tracing tool. Gently hammer edge over the tracing tool thus forming a beaded edge.

10. Tie nozzle in position for silver soldering. Be sure that it is in the centre and have three separate ties of wire.

PLATE XXIV


A Candlestick
Can be made in Brass-Copper or Bronze No 20 I.S.W.G
Traced line
3/8"
1 1/8"
A
B
1 1/2"
3/4"
Section on line A–B
1/8" Round headed Copper rivets
To be soft soldered or silver soldered
1 1/4"
1 1/2"
1/8"
2 5/8"
C
Lap 1/16"
Method of setting out pattern for foot A·B·C Triangle based on front elevation of foot
Pattern is set out in firm lines
Foot construction of Pattern in dotted lines
A
B
Method of spreading mouth of Nozzle using stretching hammer
Perspective Sketch
1/8" Holes
Extinguisher stake
1/8" Hole
1 1/4"
5/8"
1"
1/2"
7/8"
1 1/2"
2 3/4"
Pattern for handle

Put borax and water and silver solder inside the nozzle and heat until the solder melts. Remove all the iron wire and place in the pickle until all the borax has been dissolved off the job.

11. Develop the handle and cut it out of No. 18 or No. 20 I.S.W.G. metal. File it up, slightly chamfer all edges both sides. Mark position, centre dot and drill fixing holes. Remove the burrs.

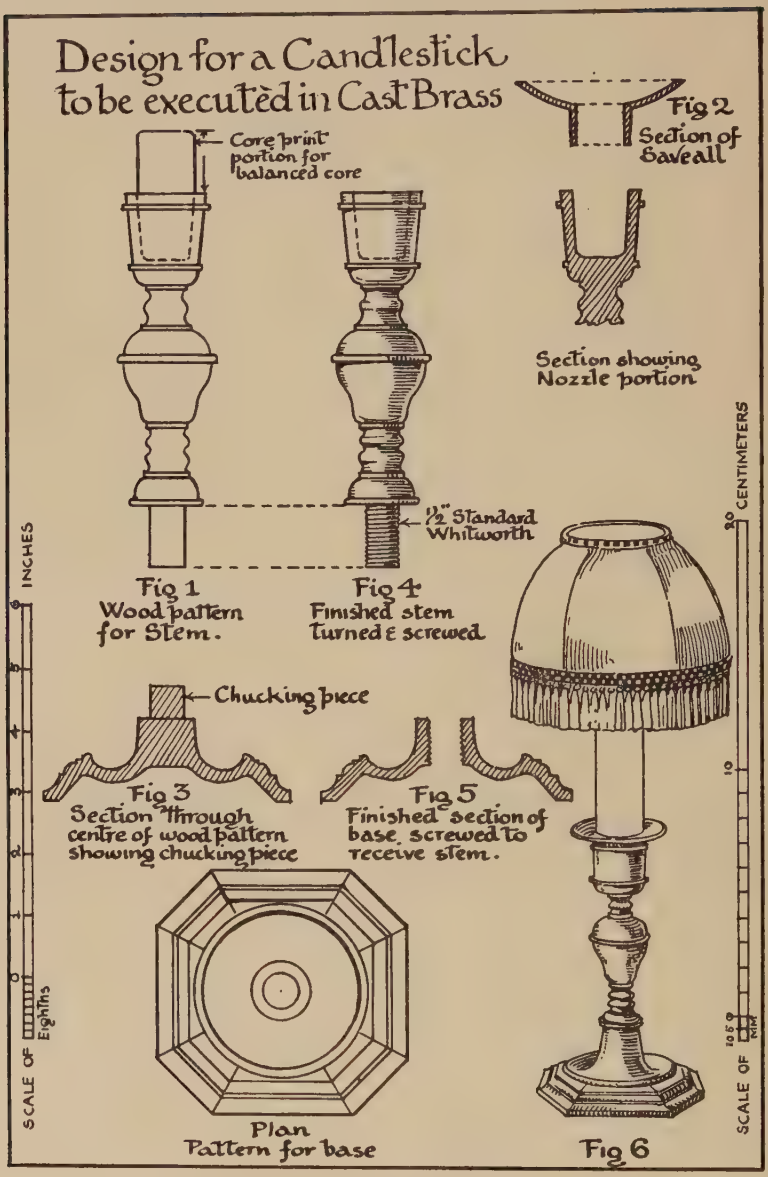
12. Hammer the handle up to the correct shape and fit to the bowl. Then soft solder handle to bowl, drill holes for rivets in bowl, fit the rivets, slightly countersink holes, hold heads of rivets in cup tool and rivet all together, forming round heads to the rivets during the process.

13. Clean up all over with emery cloth and oil and finish off with polishing paste and whiting.

NOTE. The handle could be lengthened and the end squared and riveted to the bottom member of the foot. This is slightly easier to do, but two rivets must be placed at the end instead of one, and $\frac{3}{32}''$ rivets must be used instead of $\frac{1}{8}''$.

For method of silver soldering see page 16.

PLATE XXV


Design for a Candlestick
to be executed in Cast Brass
Fig 2
Section of Saveall
Core print portion for balanced core
Section showing Nozzle portion
½" Standard Whitworth
Fig 1
Wood pattern for Stem.
Fig 4
Finished stem turned & screwed
Chucking piece
Fig 3
Section through centre of wood pattern showing chucking piece
Fig 5
Finished section of base screwed to receive stem.
Plan
Pattern for base
Fig 6
INCHES
CENTIMETERS
SCALE OF Eighths
SCALE OF

A CAST AND HAND-TURNED CANDLESTICK

Method of Procedure

1. Make an outline templet of the stem and turn up the pattern from boxwood in a lathe suitable for turning wood.

2. Turn 'save-all,' working from the inside first. Then finish the outside and 'part off' from the remainder of the wood. The hole inside the save-all should be $\frac{3}{4}''$ diameter to allow for subsequent turning.

3. Turn a circular base from a piece of boxwood. Do the top side first, then part off the base to correct depth. Hold base by chucking piece and turn out the underside of base.

4. File up the base to the octagonal shape as drawn, using a 6″ half-round cabinetmaker's rasp and a 6″ rat-tail rasp. Finish off the mouldings with metalworker's bastard and smooth files.

5. Have the three patterns cast in brass or gunmetal.

6. Anneal the castings and pickle them for about two hours or more according to strength of pickle.

7. Hold stem of candlestick in the lathe and turn out the nozzle and face the end. Remove from lathe and centre dot and drill a $\frac{1}{8}''$ hole in centre of lug at bottom of stem.

8. Turn a piece of boxwood perfectly true, size about 3″ long and $1\frac{1}{2}''$ diameter. Turn and fit one end tightly into the socket of stem. Place in lathe and see that the stem and boxwood plug run truly in alignment.

9. Hold boxwood plug in the lathe and tighten lathe centre up against the small hole in bottom of stem. Turn the stem true to the design.

10. Strike up the thread on stem, using a hand chaser. If the thread does not come up perfectly true, finish off to size with stocks and dies. Remove boxwood plug.

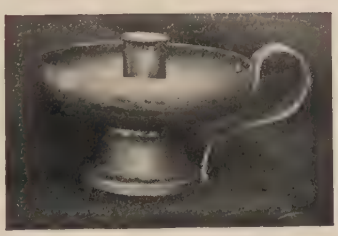
11. Hold base in the lathe by the chucking piece. Face up the base and turn out the underside.

12. Hold the base in the lathe by the bottom edge so that the chucking piece is projecting. Cut off chucking piece. Centre and drill the base (for size of drill see page 113).

13. Screw the base with taps while holding base in the lathe. The method of doing this is as follows. Hold the first taper tap with the wrench. Place point of tap in the hole. Run lathe centre up against the hole in opposite end of tap. Keep back centre tight up against the tap and turn the headstock slowly round with the left hand. This ensures that the base is tapped at right angles to the line of the base. After having screwed the base, turn the front or top side as much as possible, and finish filing up the moulding, holding the base in the lead-covered jaws of a vice.

14. Hold the save-all in the lathe and bore out the centre and round off the inside edges. Reverse save-all and turn the outside. Turn and fit tubular piece of save-all to socket of stem. Hold save-all by the tubular portion and finish off the outer edge.

15. Polish candlestick and lacquer with a colourless lacquer.



EXAMPLES OF SIMPLE WORK EXECUTED BY STUDENTS

A TEAPOT STAND

Method of Procedure

1. Cut out a circle of metal to the exact size, and file up the edge true.

2. Clean one face of the metal with fine emery cloth, and make a tracing of the design from the drawing. Lay a piece of carbon transfer paper on the metal. On this place the tracing. Now go over all the lines of the design with a bone point, remove tracing and carbon paper, and scribe in the design on the metal with a steel scriber.

3. Either cut out from the metal, with a fretsaw, that part not included by the design, or drill a series of small holes and cut out the spaces with a small chisel. File out to the line with small files of various shapes.

4. Place metal top on a smooth and flat piece of iron, and, using a small lining tool, trace in the necessary lines to complete the design. This will cause the metal to buckle, so it must be flattened with a steel flatter from both sides until it lies perfectly flat.

5. Lay metal top on a wood block and fix it in position with shoemakers' iron rivets. Face up with bastard and smooth files and finish off by using some No. 0 emery cloth wrapped round a flat file until a fine surface is obtained.

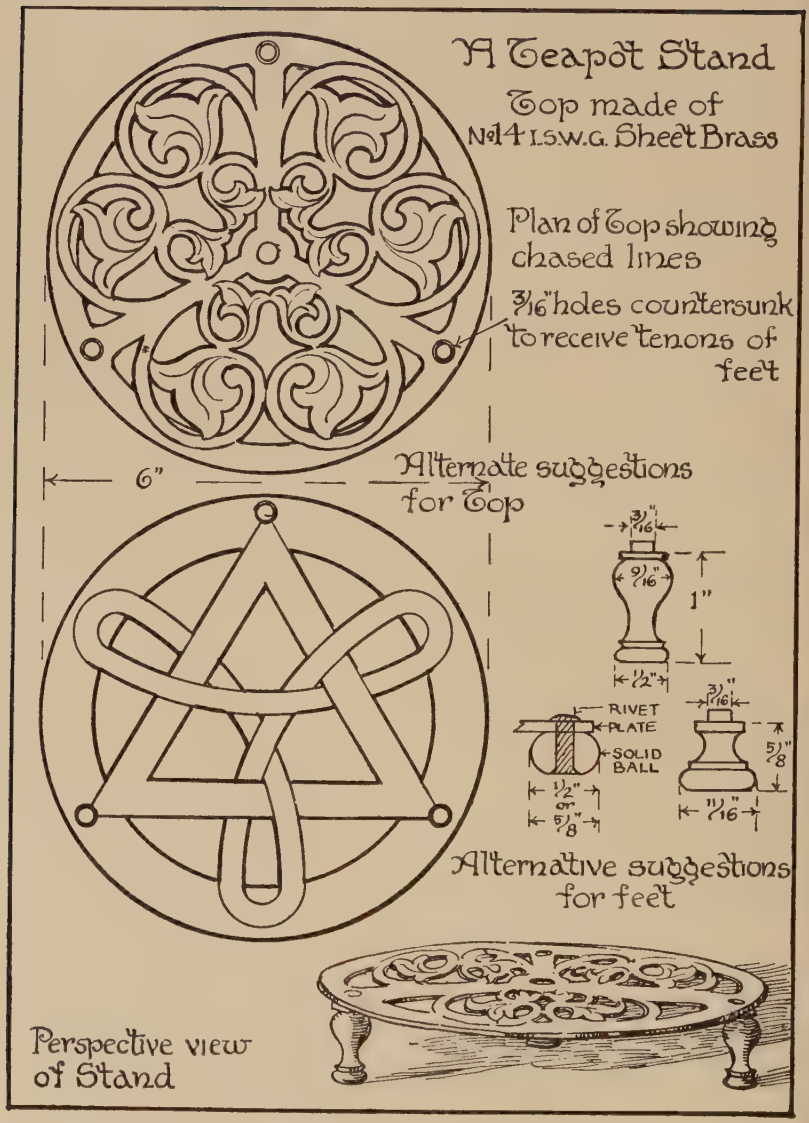
6. Centre dot and drill holes for tenons and slightly countersink. Remove metal from block and touch up where necessary with the lining tool and smooth files.

7. Make a forming tool to the shape of the foot (see page 34).

8. Place a piece of brass rod in the lathe. Rough turn to the shape of the foot and finish off with forming tool, taking care that the tenon will fit the hole drilled in the plate. Fine finish and polish feet before cutting them off. Repeat this process until all the feet have been turned.

9. Anneal the tenons on the feet.

PLATE XXVII


A Teapot Stand
Top made of
No 14 L.S.W.G. Sheet Brass
Plan of Top showing chased lines
3/16" holes countersunk to receive tenons of feet
6"
Alternate suggestions for Top
3/16"
9/16"
1"
1/2"
RIVET
PLATE
SOLID BALL
1/2" or 5/8"
5/8"
11/16"
Alternative suggestions for feet
Perspective view of Stand

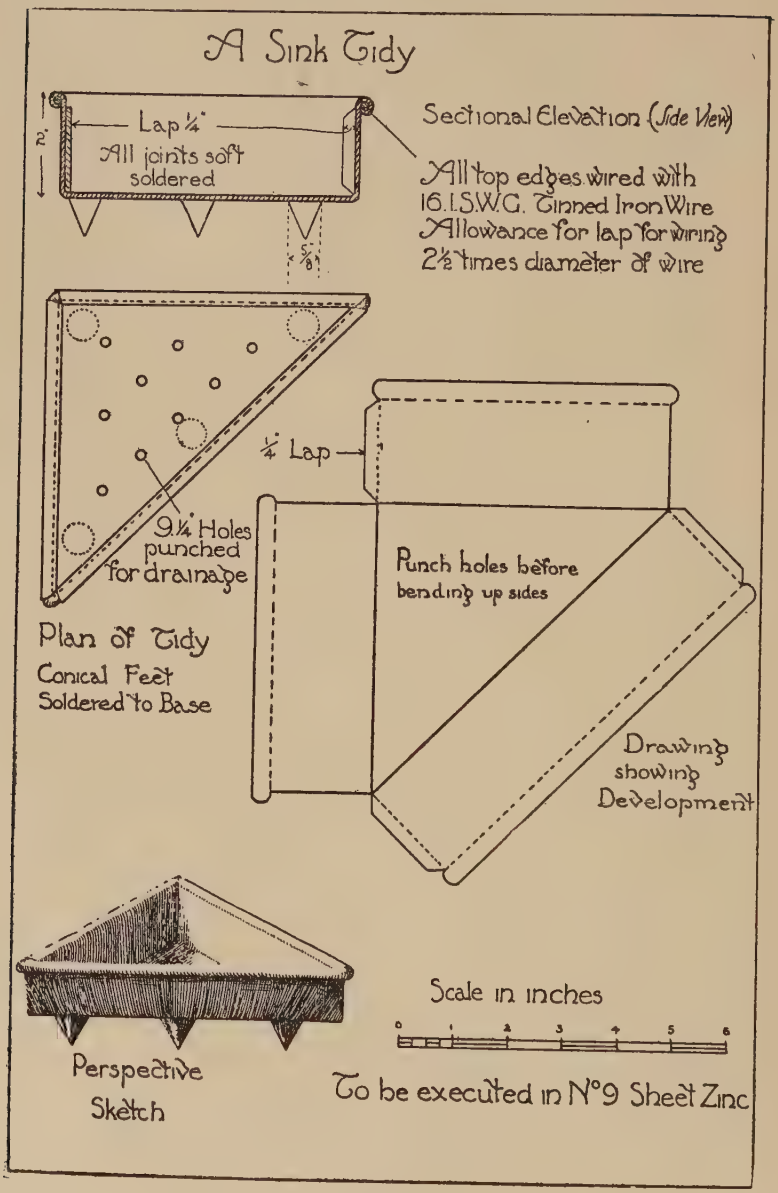
10. Hold the feet carefully between some pieces of lead in the jaws of a vice. Place top over the tenons and gently rivet over the tenon, filling up the countersunk hole. Do not hit the plate. Repeat until finished.

11. Face off tops of tenons with a smooth file and emery cloth.

12. Test stand for firmness on a surface plate. If not quite level place a sheet of No. 1 emery cloth on the surface plate, and rub the feet down until the stand is level and firm on its feet.

13. Polish with polishing paste and lacquer it if required.

PLATE XXVIII


A Sink Tidy
Lap ¼"
All joints soft soldered
2"
Sectional Elevation (Side View)
All top edges wired with 16 I.S.W.G. Tinned Iron Wire
Allowance for lap for wiring 2½ times diameter of wire
⅝"
¼" Lap
9¼" Holes punched for drainage
Plan of Tidy
Conical Feet Soldered to Base
Punch holes before bending up sides
Drawing showing Development
Perspective Sketch
Scale in inches
0 1 2 3 4 5 6
To be executed in N°9 Sheet Zinc

A SINK TIDY—No. 1

Method of Procedure

1. Set out development of tray on drawing paper and cut out the drawing. Set out development of foot (the same principle as illustrated on page 88). Test the developments by bending up the paper and measuring with a rule.

2. Lay developments on the sheet zinc and mark round them with a lead pencil. Cut them out with the shears, cutting exactly on the line drawn.

3. Mark lines where tray is to be bent with a lining tool and a hammer, resting the metal on a smooth piece of wood.

4. Punch the holes for drainage on a lead block with a flat bottomed punch.

5. Bend up the tray and soft solder the laps outside.

6. Mallet the top edges over a hatchet stake, forming a hollow to receive the wire.

7. Bend up the wire frame, making the butt joint come together in the centre of the long side. Fit it closely to the tray.

8. Place the wire frame in the groove and gently hammer the metal over the wire.

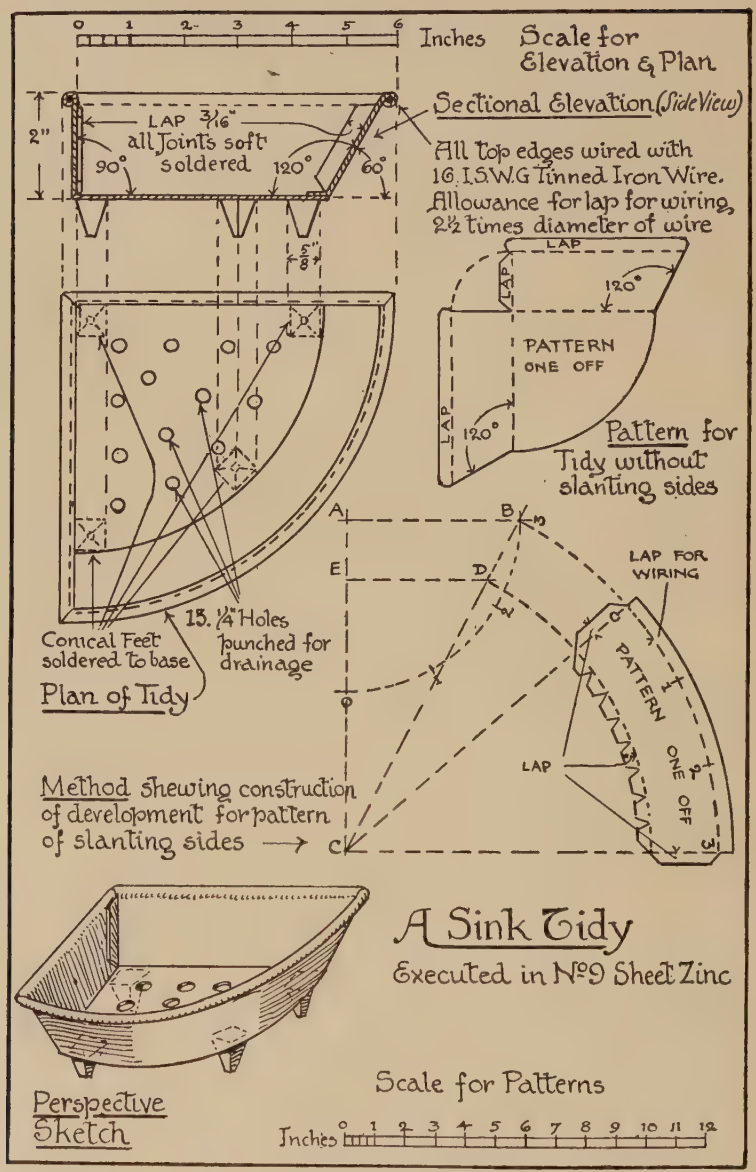
9. Smooth the wired edge by going over it with a grooving tool of the right size.

10. Bend up the feet to a cone shape, and soft solder them into position on the bottom of tray, at the same time soldering the joint in the foot. Wash the tray well in water if killed spirit has been used in the soldering.

11. Rub all over with No. 1 emery cloth, keeping all the scratches in one direction.

NOTE. The art of working zinc is to leave the job without any tool marks.

PLATE XXIX


0 1 2 3 4 5 6
Inches
Scale for Elevation & Plan
Sectional Elevation (Side View)
LAP 3/16"
all Joints soft soldered
2"
90°
120°
60°
All top edges wired with 16 I.S.W.G Tinned Iron Wire. Allowance for lap for wiring, 2½ times diameter of wire
5/8"
LAP
120°
PATTERN ONE OFF
Pattern for Tidy without slanting sides
A
B
E
D
LAP FOR WIRING
PATTERN ONE OFF
LAP
C
Method shewing construction of development for pattern of slanting sides
13. ¼" Holes punched for drainage
Conical Feet soldered to base
Plan of Tidy
A Sink Tidy
Executed in No 9 Sheet Zinc
Perspective Sketch
Scale for Patterns
Inches 0 1 2 3 4 5 6 7 8 9 10 11 12

A SINK TIDY—No. 2

Method of Procedure

This is a more difficult example than the one on page 98, but it gives extra practice in development and more difficult soldering. The square feet are also more difficult to make.

1. Set out development of body of tray on drawing paper, and also set out the development of curved front and the feet. Cut out the drawings so made. Test the developments by bending up the paper and measuring with a rule.

2. Lay the developments on a sheet of zinc, and mark round them with a lead pencil. Cut them out with the shears, cutting exactly on the line drawn.

3. Mark lines where tray and front piece are to be bent with a lining tool and a hammer, resting the metal on a smooth piece of wood.

4. Punch the holes for drainage on a lead block with a flat-bottomed punch.

5. Bend up the body of the tray, using the hatchet stake, and soft solder the corner. Bend up the curved front piece and soft solder it to the body of the tray.

6. Work down the lap over a hatchet stake ready to receive the wire frame.

7. Bend up the wire frame, making the butt joint come together in the centre of one of the straight sides. Fit it closely to the tray.

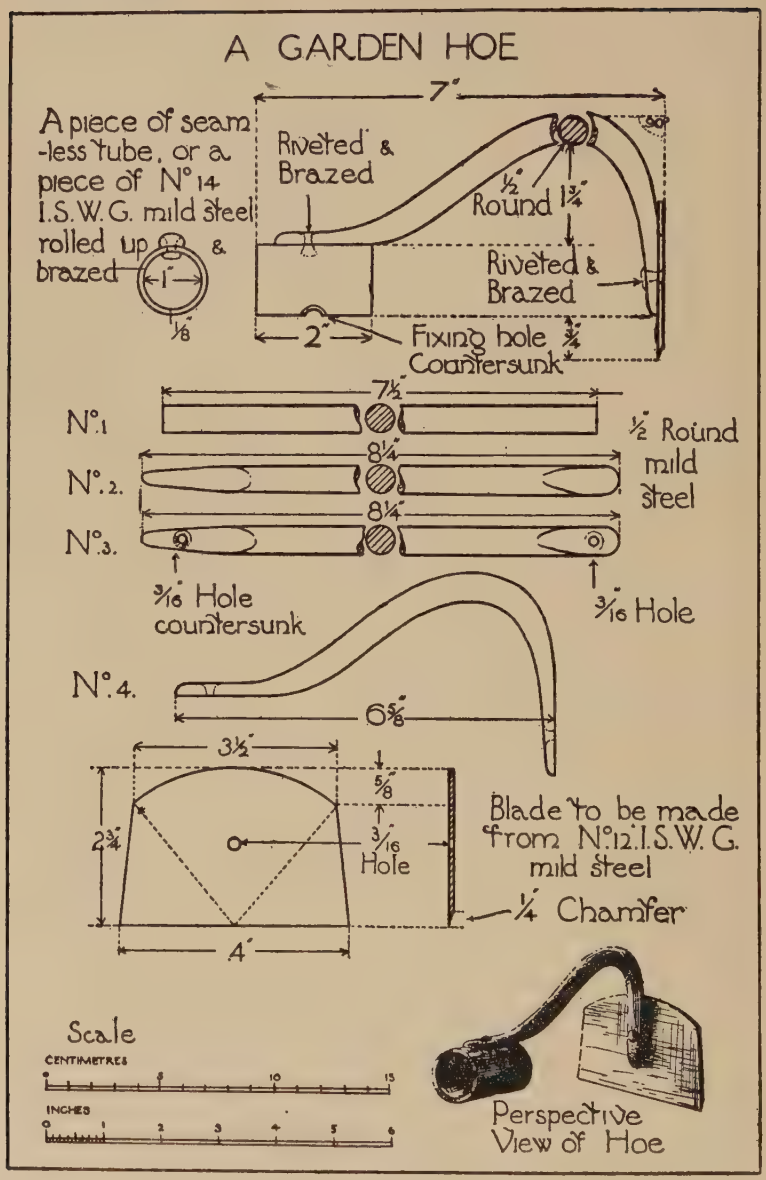
8. Place the wire frame in the groove, and gently hammer the metal over the wire. Smooth the wired edge by going over it with a grooving tool of the right size.

9. File up a piece of iron to the shape of the feet, and on this bend up the feet ; make the joint come on a corner, first of all using a mallet and then a light hammer. Solder the joints of the feet. Then solder the feet in position on the bottom of the tray.

Wash the tray well in water if killed spirit has been used in the soldering.

10. Rub all over with No. 1 emery cloth, keeping all the scratches in one direction.

PLATE XXX


A GARDEN HOE
A piece of seam-less tube, or a piece of N°14 I.S.W.G. mild steel rolled up & brazed
1"
⅛
7"
Riveted & Brazed
½" Round
1¾"
Riveted & Brazed
2"
Fixing hole ¾" Countersunk
N°.1
7½"
N°.2.
8¼"
N°.3.
8¼"
½ Round mild steel
3/16 Hole countersunk
3/16 Hole
N°.4.
6⅝"
3½"
⅝"
2¾"
3/16 Hole
Blade to be made from N°12 I.S.W.G. mild steel
¼ Chamfer
4"
Scale
CENTIMETRES
INCHES
Perspective View of Hoe

A GARDEN HOE

Method of Procedure

1. Cut off a piece of $\frac{1}{2}''$ round mild steel $7\frac{1}{2}''$ long. Hold in the tongs, heat one end and draw down to a square point as illustrated on the drawing stage No. 2. Reverse the metal and spread the end as shown in stage No. 2. Check the length, and cut off excess metal.

2. Centre dot and drill the holes. Countersink the holes on opposite sides.

3. Heat and bend up to the shape drawn. The shape should be drawn on a sheet of iron that has been chalked, the outline being drawn in pencil on the chalked surface.

4. Make a half templet of the blade in thin iron. Set out the blade on a piece of iron, using the templet and a brass scriber. Cut out the blade with a chisel and hammer, and file it up to shape.

5. Cut off a piece of tube to the correct length, and face off both ends square. Place arm in the correct position on the tube and mark the hole with a brass scriber, centre dot and drill the hole. To do this, hold the piece of tube in a Vee-block.

6. Hold the arm in the correct position on the blade, and scribe the place for the hole. Centre dot, drill and countersink the hole on the opposite side.

7. Obtain one flat-headed rivet and one half round-headed rivet, and see that they fit the holes. Cut them off if necessary to the correct length and anneal them.

8. Rivet the arm to the socket using the flat-headed rivet, and rivet the blade to the arm.

9. Braze the arm to the socket and the blade to the arm.

10. Place the hoe in the sulphuric acid pickle (see page 20), and leave until all the borax and scale have been removed.

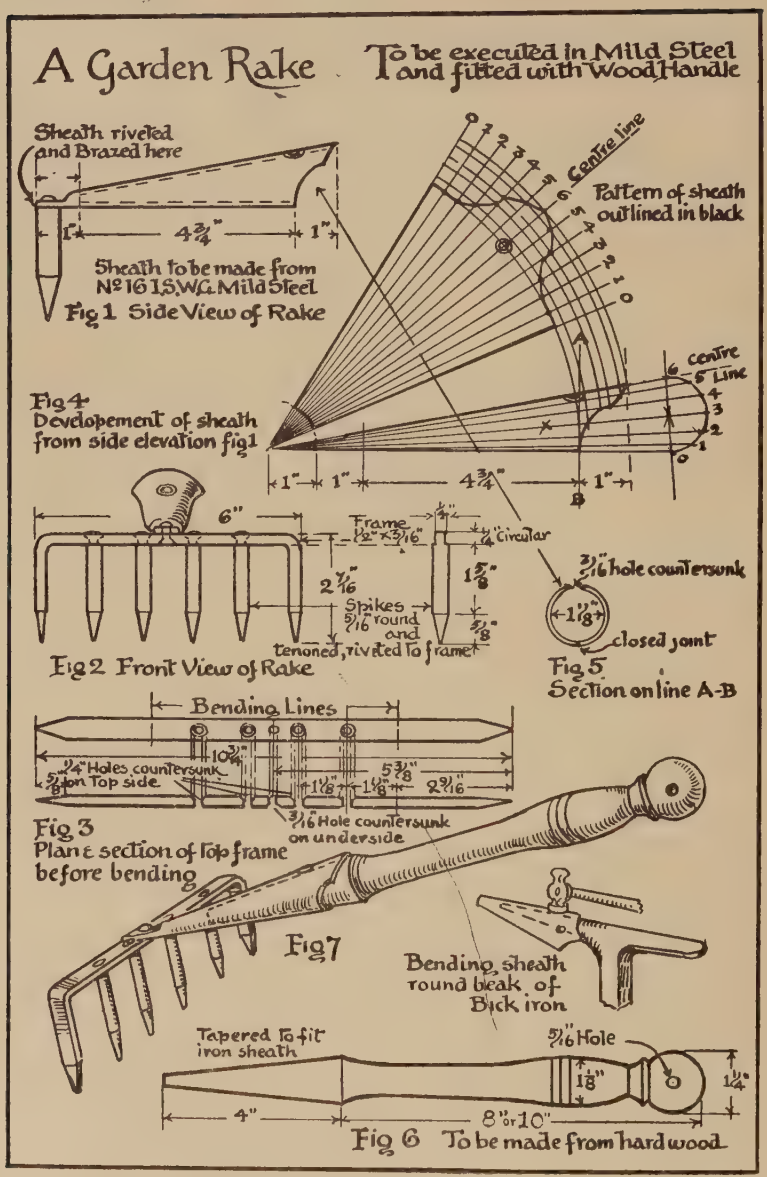
11. File off all the excess brass, and smooth the job up all over.

12. Place socket on the point of a ' bick ' iron, mark and centre dot position of fixing hole.

13. Drill and countersink the fixing hole ; remove burr from the inside with a half round file.

14. Give hoe two coats of a lead paint.

PLATE XXXI


A Garden Rake
To be executed in Mild Steel and fitted with Wood Handle
Sheath riveted and Brazed here
1"
4¾"
1"
Sheath to be made from No 16 I.S.W.G. Mild Steel
Fig 1 Side View of Rake
Centre line
Pattern of sheath outlined in black
Fig 4 Development of sheath from side elevation fig 1
1" 1" 4¾" 1"
6"
Frame ½" × 3/16"
¼" Circular
2 7/16"
1 5/8"
Spikes 5/16" round and tenoned, rivited to frame
5/8"
Fig 2 Front View of Rake
3/16" hole countersunk
1 1/8"
closed joint
Fig 5 Section on line A-B
Bending Lines
¼" Holes countersunk 5/8" on Top side
10¾"
5 3/8"
1⅛"
1⅛"
2 9/16"
3/16" Hole countersunk on underside
Fig 3 Plan e section of top frame before bending
Fig 7
Bending sheath round beak of Bick iron
Tapered to fit iron sheath
5/16" Hole
1⅛"
1¼"
4"
8" or 10"
Fig 6 To be made from hard wood

A GARDEN RAKE

Method of Procedure

1. Set out development of conical sheath for handle on drawing paper and from the drawing cut out the half templet. Stick this half templet on to a sheet of thin metal, cut out the metal and trim the edges up with a smooth file if necessary.

2. Using the templet, mark off the development of the sheath on to a piece of mild steel, using a brass scriber. Cut out the sheath with a chisel and hammer, and true up the edges with a file. Mark position, centre dot, drill and countersink the fixing hole.

3. Heat the sheath and bend it up over the ' bick ' iron as illustrated. Flatten the end. Mark, centre dot and drill the hole for the rivet.

4. Point one end of a piece of $\frac{1}{2}'' \times \frac{3}{16}''$ mild steel ; measure off correct length for outside frame, and cut it off from the length of iron. Point the remaining end of the frame piece.

5. Set out the pointed piece of iron for the frame, mark the necessary holes and centre dot the position of the bending lines as well as the holes. Drill and countersink the holes, taking care to countersink the holes on the right side.

6. Heat the frame and bend up the end pieces, using the centre dots as a guide. These can be seen when the iron is red hot.

7. Obtain a short length of $\frac{5}{16}''$ round mild steel. Forge one end to a point as shown on the drawing, and then cut it off. Keep on repeating this operation until all the spikes have been cut off. Mark the length on each spike with the edge of a file. Place this mark level with the top of the jaws of the vice, and hold the spike tightly. File the tenon until it fits into the hole in the frame and make it the correct length. Take care that the shoulder of the tenon is level.

8. Anneal the tenons on the spikes. Hold the spikes lengthwise in the vice and rivet them in the frame.

9. File the metal clean where the handle is to be fixed, and rivet handle to frame. Braze handle to frame and place rake in the pickle used for ironwork, until all the borax has dissolved. File off excess brass and tighten up the spikes.

10. Give the rake two coats of a lead paint.

11. Turn the wood handle in the lathe, taking care that the taper portion fits the iron sheath correctly. Polish the handle with wax.

12. Drive the wood handle into the iron sheath of the rake and fix in position with a small round-headed screw.

MISCELLANEOUS MODELS

No. 1—Page 108

1. Make a drawing of this corner clamp on drawing paper.

2. Cut out one quarter of the drawing for use as a templet and stick this on a piece of thin metal. Then cut it out and trim up the edges of the metal with a smooth file, and punch the holes.

3. Using the templet, set out the clamp on the metal and mark the holes.

4. Cut out the clamp, trim up all the edges with a smooth file, and punch the holes on a lead block.

5. Mark the bending lines of the clamp with a lining tool on a lead block.

Bend up the clamp in a vice and sharpen up the corners with a hammer.

No. 2—Page 108

1. Make a development of this sketch on drawing paper, and cut out the development as drawn.

2. Using this as a templet lay it on the metal. Scribe round the edges and mark the holes.

3. Cut out the clamp. Trim up the edges with a file, punch the holes and file off the burrs.

4. Mark the bending lines with a lining tool on a lead block, and bend up the clamp in a vice. Sharpen up the corners with a hammer.

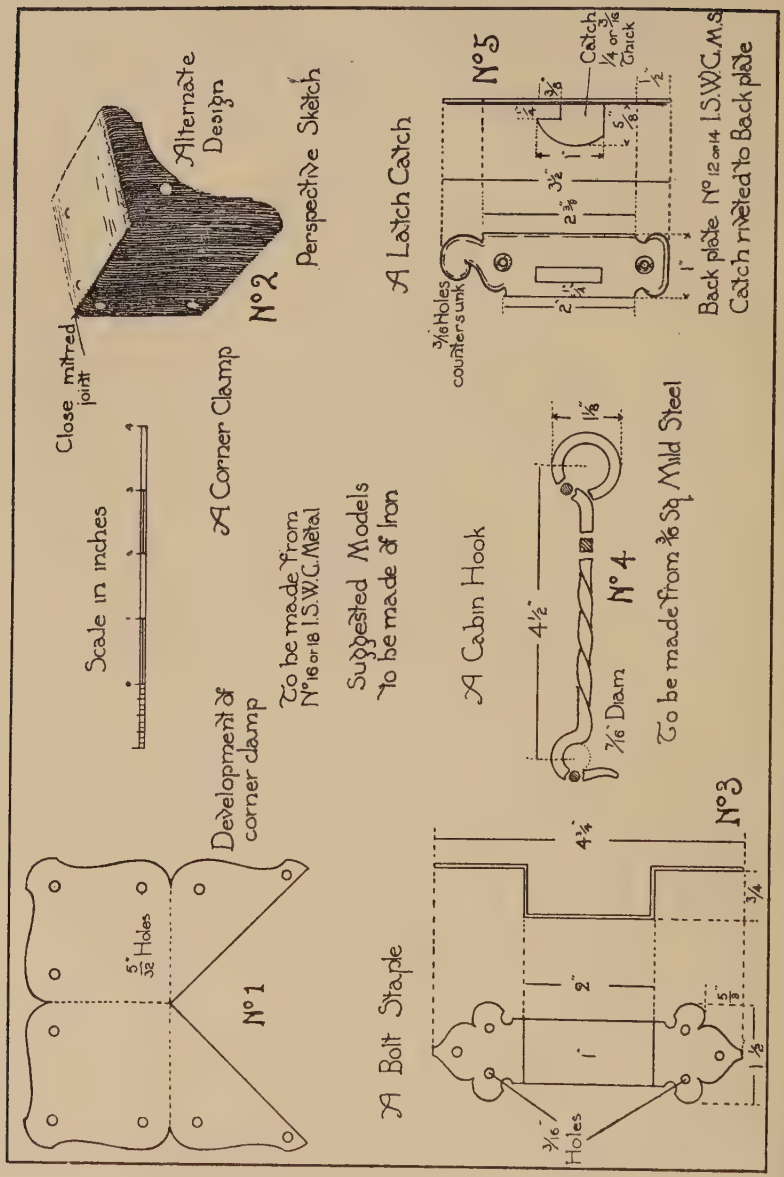
5. If required the close mitred joint at corner could be soft soldered or brazed from the inside.

No. 3—Page 108

1. Make a templet of one end of the staple from thin sheet metal.

2. Measure the correct length of material required, and draw a line down the centre of the metal to be used. Place the

PLATE XXXII


Alternate Design
Perspective Sketch
Close mitred joint
Scale in inches
A Corner Clamp
No 2
Development of corner clamp
To be made from No 16 or 18 I.S.W.G. Metal
Suggested Models To be made of Iron
A Latch Catch
No 1
5/32 Holes
A Bolt Staple
A Cabin Hook
No 3
No 4
No 5
3/16 Holes countersunk
Catch 1/4 or 5/16 Thick
Back plate No 12 or 14 I.S.W.G. M.S
Catch riveted to Back plate
7/16 Diam
To be made from 3/8 Sq Mild Steel
3/16 Holes

templet at one end, scribe round it and mark the holes. Repeat this at the opposite end.

3. Cut out the staple and trim up all the edges with a file. Centre dot and drill the holes. File off the burrs.

4. Bend up the staple to the sizes given.

No. 4—Page 108

1. Obtain a length of $\frac{3}{16}''$ square mild steel. Measure off length of metal required for the eye. Heat it in the forge fire and shape the end round with a hammer.

2. Heat the rounded end and bend up the eye as illustrated on page 34.

3. Measure off the metal for the hook portion, and shape it circular in section with a hammer.

4. Bend up the hook (hot).

5. Twist the centre (cold).

No. 5—Page 108

1. Make a templet of the backplate of thin sheet metal.

2. Get a piece of $1'' \times \frac{1}{8}''$ hooping and mark round the templet with a brass scriber.

3. Cut out the shape with a chisel and a hammer, centre dot the fixing holes.

4. File up the backplate and chamfer the edges as shown. Face with bastard and smooth files. Then hammer down the chamfers. Drill and countersink fixing holes.

5. Centre dot and drill two or three holes, and file them into one, so making a slot to hold the catch.

6. File catch out of a piece of $1'' \times \frac{3}{16}''$ mild steel, and fit it to the slotted hole. Bevel the back of the slot and anneal the catch. Rivet catch to backplate and finish off with emery cloth and oil.

N.B. The finish of these articles depends upon the metals of which they are made and the purposes for which they are required.

IV

APPENDICES AND GLOSSARY

SUITABLE METALS FOR USE IN SCHOOLS

Mild steel of all kinds.

Carbon tool steel for all kinds of small cutting tools and punches, etc.

Brass in sheet, tube, wire, rod and angles.

Copper in sheet form, wire and tape.

Gilding metal in sheet form and wire.

Zinc sheet, No. 9 I.S.W.G. ; size of sheets, $9' \times 3'$, $6' \times 3'$.

Tinned plate, No. IX, No. 28 I.S.W.G. $14'' \times 20''$.

Lead blocks, $8'' \times 6'' \times 1''$.

Iron blocks, $10'' \times 12'' \times 2''$, for use in chopping out.

Brass, copper, iron, and tinned iron rivets of various sizes and shapes.

Tinman's blowpipe solder.

Silver solder (white) in sheet, No. 22 I.S.W.G. or No. 20 I.S.W.G. wire.

Spelter in medium grain.

TABLE OF SIZES FOR TAPPING AND CLEARANCE HOLES

Dimensions given are for Training Purposes only.

	WHITWORTH STANDARD		WHITWORTH GAS THREADS				BRITISH STD. FINE			
	TAPPING HOLE	CLEARANCE HOLE	TAPPING HOLE		CLEARANCE HOLE		TAPPING HOLE		CLEARANCE HOLE	
1/8	3/32	9/64								
3/16	9/64	13/64								
1/4	3/16	17/64	·4506	29/64	·518	33/64	·1988	13/64	17/64	
5/16	1/4	21/64					·2543	1/4	21/64	
3/8	19/64	25/64	·5889	9/32	·6563	43/64	·3110	21/64	25/64	
7/16	23/64	29/64					·3664	3/8	29/64	
1/2	13/32	33/64	·7342	47/64	·8257	27/32	·4200	27/64	33/64	
9/16	15/32	37/64					·4825	31/64	37/64	
5/8	33/64	41/64					·5335	35/64	41/64	
11/16	37/64	45/64					·5960	39/64	45/64	
3/4	5/8	25/32	·9495	61/64	1·041	1 1/16	·6433	21/32	25/32	
13/16	11/16	27/32								
7/8	47/64	29/32								
15/16	51/64	31/32								
1	27/32	1 1/32	1·1925	1 13/64	1·309	1 21/64				

BRITISH ASSOCIATION (B.A)				
No	DIAMETER		TAPPING HOLE		CLEARANCE HOLE
0	·2362	15/64	·1890	13/64	1/4
1	·2087	13/64	·1662	11/64	7/32
2	·1850	3/16	·1467	5/32	13/64
3	·1614	5/32	·1269	9/64	11/64
4	·1417	9/64	·1105	1/8	5/32
5	·1260	1/8	·0981	7/64	9/64
6	·1102	7/64	·0852	3/32	1/8
7	·0984	3/32	·0757	5/64	7/64
8	·0866	3/32	·0663	1/16	7/64
9	·0748	5/64	·0564	1/16	9/32
10	·0669	1/16	·0504	3/64	5/64

DEALERS IN TOOLS AND MATERIALS

Tools and materials can be obtained from the following among other firms :

General metalworkers' tools, smiths' and tinmans' tools :

BUCK & HICKMAN, Whitechapel Road, London, E.

Sheet and bar iron and tool steel, bolts, nuts, etc. :

BUCK & HICKMAN, Whitechapel Road, London, E.

Raising hammers and stakes :

Jewellers' emery paper and silver solder :

C. J. PLUCKNETT & CO., Ltd., Poland Street, London, W.

Brass and bronze castings :

P. WILKINSON & SONS, Tottenham Mews, Tottenham Street, Tottenham Court Road, London, W.

Copper, brass, gilding metal, zinc spelter, etc., in sheet, rod, wire, tubing, washers and rivets :

SMITH & SONS, LTD., St. John's Square, Clerkenwell, London, E.C.

Fancy wires, mouldings and frets or pierced bandings :

Z. DESSAR & CO., 5 and 6 Museum Street, Oxford Street, London, W.

LEIGH & LETCHTER, 4 Myddleton Street, Clerkenwell, E.C.

Boxwood :

W. MARSHALL & SON, LTD., 256-8 Old Street, London, E.C.

Drawing Instruments :

J. HALDEN & CO., LTD., 75B Victoria Street, Westminster, London, S.W. 1.

GLOSSARY

ALIGNMENT. To be in a straight line.

ANNEAL. To soften by heating and gradually cooling.

B.A. DIE. B.A., British Association ; die, a contrivance for cutting a screw thread, usually made of tool steel.

BALL HEAD STAKE. A piece of iron or steel with a ball-shaped knob at the end.

BASTARD FILE. Files are cut with a number of teeth to the inch. A bastard file is the one that comes between a rough file and a second cut file.

BENDING BARS. Two pieces of iron which fit closely together, between which pieces of thin metal are held so that they may be bent.

BICK IRON. A piece of iron in the form of a letter T ; one end is usually pointed and round.

BINDING WIRE. Soft iron wire, comparatively thin, used for binding pieces of work together.

BLANK. A flat piece of metal cut to a shape, ready for working up into a required form.

BUCKLED. Irregular, wavy or bent.

BURRS. Very thin, sharp pieces of metal which are thrown up by the action of tools.

CHAMFER. A bevelled edge, or an edge that is made at an angle to the face.

CHUCK. A revolving vice attached to the spindle of a lathe.

CHUCKING PIECE. A piece of metal which has been left on a job purposely, so that the job can be held in the lathe. This piece is afterwards removed.

CLEARING HOLE. A hole made to allow a screw or a bolt to slip through.

COUNTERSINK. To bevel or chamfer the inside edges of a hole.

EXTINGUISHER STAKE. A small bick iron, so called because it was used for making extinguishers in the seventeenth and eighteenth centuries.

EYE. Usually denotes a circular ring or hole on the end of a rod.

FILLET. A projecting piece of wood or metal usually long compared with its width or thickness.

FLAT. A flat surface.

FLATTER. A steel tool or punch, usually with a square flat face, used for smoothing or flattening metal surfaces.

FORMING TOOLS. Tools made of various shapes, usually to definite forms, used in the lathe to bring the work to a uniform shape ; they are used for repetition work.

FRIDGILENE. The name of a patent lacquer which can be used on cold work.

HAND CHASER. A tool, used by hand, to form a screw thread on work held in the lathe.

HOLLOW BIT TONGS. Tongs used by blacksmiths to hold round rods.

I.S.W.G. Imperial Standard Wire Gauge, a tool for measuring the thickness or diameter of metals.

LACQUER. A liquid that is sprayed or brushed over metal to preserve the surface ; sometimes the work is dipped into the lacquer.

LEAD PAINT. A paint containing white lead.

LINING TOOL. A tool with a thin edge like a chisel, used for making thin lines on metal surfaces, but not for cutting.

LUG. A projecting piece on a piece of work.

MANDREL. An axis on which work is fixed for turning.

PANE OR PENE. The opposite end to the face of a hammer head.

PART OFF. To cut apart, usually in a lathe.

PARTING OFF. To separate by cutting with a parting tool.

PEARLING PUNCH. A punch that is rounded at the end, the shape of a pearl.

PICKLE. A mixture of acids for cleaning metals.

PINS. Usually shoemakers' rivets are meant ; they are short, thick nails with small heads.

PLANISH. To make smooth with a planishing hammer, to bring to a plane surface.

PLUG. A stopper that fills up a hole or recess like a cork.

PUNCH. A steel tool for performing a certain operation at one blow.

REPOUSSÉ. The art of modelling metal in relief, usually of an ornamental character.

RIPPER. A round-ended tool used by brassfinishers to turn work in the lathe. Usually held in the hand.

SAVE-ALL. The pan or shallow plate that is usually placed at the bottom of a candle to catch the grease.

Scarf. To make two pieces of metal of a particular shape, so that they overlap and can be joined together.

Scribe. A writer.

Scriber. A pointed tool used for writing or drawing on metal.

Sheffield Lime. A prepared lime, used for polishing metals.

Shellac. A crude resin lac, a varnish.

Stake. A piece of iron or steel, made in various shapes, with a pointed and squared end which fits into a heavy wood block. Used for shaping metal.

Stocks and Dies. A combination of tools for cutting screw threads ; the stocks hold the dies.

Sweating. A term used when soft soldering, meaning to thoroughly fill the joint with solder so that it sweats out at the edges.

Taper Tap (first). Taps for cutting screw threads ; they are sold in sets of three, first taper, second taper and plug.

Tapping Holes. Holes drilled a size so that they will allow a full thread to be cut by a tap. If the hole were too small a tap would not enter, if too large it would not be able to hold a full thread.

Tang. The pointed end of a tool that is driven into the wood handle.

Tracer. A tool similar to a lining tool for tracing or making lines on metal.

Tripoli. A fine earth used in polishing, found at Seneca, Missouri, U.S.A.

Upset. To thicken up, a term used by blacksmiths ; to jump up a piece of metal. The metal is made white hot and then jumped on an iron block or hammered so that the part heated is made thicker.

Vee Block. A rectangular piece of metal with a vee cut down the centre.

Wobble. To move from side to side irregularly.

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